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PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

PAPERS READ BEFORE THE ACADEMY.

I.

QUATERNION INVARIANTS OF LINEAR VECTOR FUNCTIONS AND QUATERNION DETERMINANTS. By CHARLES J. JOLY, M.A.

[Read June 8, 1896.]

1. *Introductory.*—This Paper is, to a certain extent, supplementary to a Paper on "The Scalar Invariants of Two Linear Vector Functions," which was published in vol. xxx. of the Transactions of the Royal Irish Academy. The notation of that Paper is followed as closely as possible, so as to facilitate occasional references to it.

The quaternion invariants being simply expressible as quotients of two determinants with vector constituents, it seems desirable to consider briefly such determinants, and to point out the geometrical meaning of their vanishing in certain simple cases.[1]

2. *Expansion of determinants with quaternion constituents.*—Because quaternion multiplication is not commutative, a determinant whose constituents are quaternions is unmeaning until some convention is adopted respecting its expansion. If it be agreed that the order of the constituents in the expansion shall follow the order of the rows, all indefiniteness is removed.

[1] Determinants, whose constituents are alternate numbers, have been considered by Clifford ("Mathematical Papers," p. 277). If i_1 and i_2 are any two constituents, $i_1^2 = i_2^2 = 0$, and $i_1 i_2 + i_2 i_1 = 0$, these being the defining formulæ for alternate numbers.

On this supposition,

$$\begin{vmatrix} p & q \\ p' & q' \end{vmatrix} = pq' - qp', \quad \text{but not} \quad pq' - p'q;$$

$$\begin{vmatrix} p & q \\ p & q \end{vmatrix} = pq - qp = 2V.VpVq, \quad \text{and} \quad \begin{vmatrix} p & p \\ q & q \end{vmatrix} = pq - pq = 0.$$

It is also obvious that if x is any scalar,

$$\begin{vmatrix} p & q \\ p' & q' \end{vmatrix} = \begin{vmatrix} p & xp + q \\ p' & xp' + q' \end{vmatrix}, \quad \text{but not} \quad = \begin{vmatrix} p & q \\ xp + p' & xq + q' \end{vmatrix}.$$

Thus the columns may be treated as in ordinary determinants with scalar constituents; but it is not lawful to treat the rows in this manner. The former of these processes is consistent with the convention that the order of the constituents shall follow the order of the rows; the latter violates this convention.

3. *Multiplication of a quaternion and a scalar determinant.*—Again,

$$\begin{vmatrix} p & q \\ p' & q' \end{vmatrix} . \begin{vmatrix} x & y \\ x' & y' \end{vmatrix} = \begin{vmatrix} px + qy & px' + qy' \\ p'x + q'y & p'x' + q'y' \end{vmatrix} = \begin{vmatrix} px + qx' & py + qy' \\ p'x + q'x' & p'y + q'y' \end{vmatrix},$$

the p and q being here, as elsewhere in this Paper, quaternions, and the x and y being scalars. Similar processes hold for determinants of any order.

Further, it is easy to see that, if $p = w + ix + jy + kz$, with similar expressions for the dotted letters,

$$\begin{vmatrix} p & p' & p'' \\ p & p' & p'' \\ p & p' & p'' \end{vmatrix} = \begin{Vmatrix} 1 & i & j & k \\ 1 & i & j & k \\ 1 & i & j & k \end{Vmatrix} . \begin{Vmatrix} w & x & y & z \\ w' & x' & y' & z' \\ w'' & x'' & y'' & z'' \end{Vmatrix}.$$

4. *Determinants with identical rows.*—As geometrical examples, observe that if α, β, γ, δ, &c., are vectors,

$$\begin{vmatrix} \alpha & \beta \\ \alpha & \beta \end{vmatrix} = 2V\alpha\beta;$$

$$\begin{vmatrix} \alpha & \beta & \gamma \\ \alpha & \beta & \gamma \\ \alpha & \beta & \gamma \end{vmatrix} = 2(\alpha V\beta\gamma + \beta V\gamma\alpha + \gamma V\alpha\beta) = 6S\alpha\beta\gamma;$$

and

$$\begin{vmatrix} \alpha & \beta & \gamma & \delta \\ \alpha & \beta & \gamma & \delta \\ \alpha & \beta & \gamma & \delta \\ \alpha & \beta & \gamma & \delta \end{vmatrix} = 6\,(\alpha S\beta\gamma\delta - \beta S\alpha\gamma\delta + \gamma S\alpha\beta\delta - \delta S\alpha\beta\gamma) = 0.$$

Determinants of this type enter largely into the treatment of hyper-space by means of a symbolic algebra analogous to quaternions.

Generally, also, the determinant of the fourth order whose rows are identical, and whose constituents are quaternions, vanishes identically. For, if p, q, r, and s are four arbitrary quaternions, the transformation

$$\begin{vmatrix} p & q & r & s \\ p & q & r & s \\ p & q & r & s \\ p & q & r & s \end{vmatrix} = \begin{vmatrix} p & q & r & 1 \\ p & q & r & 1 \\ p & q & r & 1 \\ p & q & r & 1 \end{vmatrix} \frac{aSp + bSq + cSr + dSs}{d}$$

(in which $$aVp + bVq + cVr + dVs = 0)$$

is the result of adding the first, second, and third columns multiplied by a, b, and c to the fourth multiplied by d, and then dividing by d.

Expanding the transformed determinant by the minors formed from the first and second rows, it is seen to vanish identically.

Again, if ϕ_1, ϕ_2, ϕ_3, and ϕ_4 are any linear vector functions,

$$\begin{vmatrix} \phi_1\alpha & \phi_1\beta & \phi_1\gamma & \phi_1\delta \\ \phi_2\alpha & \phi_2\beta & \phi_2\gamma & \phi_2\delta \\ \phi_3\alpha & \phi_2\beta & \phi_3\gamma & \phi_2\delta \\ \phi_4\alpha & \phi_4\beta & \phi_4\gamma & \phi_4\delta \end{vmatrix} = 0.$$

5. *Geometrical interpretations concerning vanishing determinants.*—If

$$\begin{vmatrix} \alpha & \beta \\ \alpha' & \beta' \end{vmatrix} = 0, \quad \text{or} \quad \alpha\beta' = \beta\alpha',$$

the four vectors are coplanar; the angle between α and β' is equal to that between β and α'; and, if the vectors are coinitial, the triangle determined by α and β' is equal to that determined by β and α'.

If

$$\begin{vmatrix} 1 & 1 & 1 \\ \alpha & \beta & \gamma \\ \alpha & \beta & \gamma \end{vmatrix} = 0,$$

the vectors, if coinitial, terminate on a line. In fact,

$$\begin{vmatrix} \beta - \alpha & \gamma - \alpha \\ \beta - \alpha & \gamma - \alpha \end{vmatrix} = 0,$$

or $\beta - \alpha$ is parallel to $\gamma - \alpha$.

Consider the quaternion

$$q = \begin{vmatrix} \alpha' & \beta' & \gamma' \\ \alpha & \beta & \gamma \\ \alpha & \beta & \gamma \end{vmatrix} = 2\,(\alpha' V\beta\gamma + \beta' V\gamma\alpha + \gamma' V\alpha\beta);$$

its conjugate is

$$Kq = \begin{vmatrix} \alpha & \beta & \gamma \\ \alpha & \beta & \gamma \\ \alpha' & \beta' & \gamma' \end{vmatrix} = 2\,(V\beta\gamma\,.\,\alpha' + V\gamma\alpha\,.\,\beta' + V\alpha\beta\,.\,\gamma');$$

and its scalar may also be expressed as a determinant,

$$Sq = \begin{vmatrix} \alpha & \beta & \gamma \\ \alpha' & \beta' & \gamma' \\ \alpha & \beta & \gamma \end{vmatrix} = (\gamma\alpha'\beta - \beta\alpha'\gamma) + (\alpha\beta'\gamma - \gamma\beta'\alpha) + (\beta\gamma'\alpha - \alpha\gamma'\beta),$$

the terms being grouped so that the pairs within the brackets are scalars. This may serve as a particular example of the effect of interchanging the rows.

If α', β', γ' are regarded as the points of application of the forces $V\beta\gamma$, $V\gamma\alpha$, and $V\alpha\beta$, respectively, $Vq = 0$ expresses that the sum of the (vector) moments of these forces with respect to the origin of vectors is zero, or that the resultant of the forces is a single force through the origin; $Sq = 0$ expresses that the virial of the forces with respect to the origin is zero; and generally $q = 0$ expresses, in Hamilton's phraseology, that the forces are equivalent to a single force, and that the origin is the *centre* of the forces, being that point for which their *total moment* q vanishes, or, more generally, is a minimum.[1]

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[1] "Elements of Quaternions," Art. 414 (16). What is now called the *virial*, was called by Hamilton the *total tension*. By Art. 7 of the present Paper the relation of these six vectors may be illustrated by means of a quadric.

6. ***Quaternion invariant, linear with respect to each of three linear vector functions, expressed as a quotient of determinants.***—Having, perhaps, sufficiently dwelt on the manipulation of these determinants with non-commutative constituents, I shall now show that

$$\begin{vmatrix} \phi_1\alpha & \phi_1\beta & \phi_1\gamma \\ \phi_2\alpha & \phi_2\beta & \phi_2\gamma \\ \phi_3\alpha & \phi_3\beta & \phi_3\gamma \end{vmatrix} \frac{1}{S\alpha\beta\gamma} = q(\phi_1, \phi_2, \phi_3)$$

is a quaternion invariant of the three linear vector functions ϕ in the sense that it is independent of the vectors α, β, and γ. This may be done by expressing α, β, and γ in terms of any three vectors such as i, j, and k, and using the methods indicated in Art. 3, or by direct expansion, which is to be preferred, as exhibiting more clearly the dependence of the determinant on the linear vector functions. Thus,

$$\begin{aligned} & q(\phi_1, \phi_2, \phi_3)\, S\alpha\beta\gamma \\ &= \phi_1\alpha(\phi_2\beta\phi_3\gamma - \phi_2\gamma\phi_3\beta) + \phi_1\beta(\phi_2\gamma\phi_3\alpha - \phi_2\alpha\phi_3\gamma) \\ &\qquad + \phi_1\gamma(\phi_2\alpha\phi_3\beta - \phi_2\beta\phi_3\alpha) \\ &= l_3(\phi_1, \phi_2, \phi_3)\, S\alpha\beta\gamma \\ &+ \phi_1\alpha S(\phi_2\beta\phi_3\gamma - \phi_2\gamma\phi_3\beta) + \phi_1\beta S(\phi_2\gamma\phi_3\alpha - \phi_2\alpha\phi_3\gamma) \\ &\qquad + \phi_1\gamma S(\phi_2\alpha\phi_3\beta - \phi_2\beta\phi_3\alpha) \\ &- \phi_2\alpha S(\phi_3\beta\phi_1\gamma - \phi_3\gamma\phi_1\beta) - \phi_2\beta S(\phi_3\gamma\phi_1\alpha - \phi_3\alpha\phi_1\gamma) \\ &\qquad - \phi_2\gamma S(\phi_3\alpha\phi_1\beta - \phi_3\beta\phi_1\alpha) \\ &+ \phi_3\alpha S(\phi_1\beta\phi_2\gamma - \phi_1\gamma\phi_2\beta) + \phi_3\beta S(\phi_1\gamma\phi_2\alpha - \phi_1\alpha\phi_2\gamma) \\ &\qquad + \phi_3\gamma S(\phi_1\alpha\phi_2\beta - \phi_1\beta\phi_2\alpha), \end{aligned}$$

in which

$$l_3(\phi_1, \phi_2, \phi_3) = \frac{\Sigma S\phi_1\alpha(\phi_2\beta\phi_3\gamma + \phi_3\beta\phi_2\gamma)}{S\alpha\beta\gamma}$$

is a scalar invariant, noticed in Art. 22 of the Paper already referred to.

Now, if ϕ_2' is the conjugate of ϕ_2,

$$S(\phi_2\beta\phi_3\gamma - \phi_2\gamma\phi_3\beta) = S(\phi_3'\phi_2 - \phi_2'\phi_3)\beta\,.\,\gamma = 2S\eta_{23}\beta\gamma,$$

if η_{23} is the spin vector or non-conjugate part of $\phi_3'\phi_2$.* Hence, if Σ denotes summation for cyclical transposition of α, β, and γ,

$$\Sigma\phi_1\alpha S(\phi_2\beta\phi_3\gamma - \phi_2\gamma\phi_3\beta) = 2\Sigma\phi_1\alpha S\eta_{23}\beta\gamma = 2\phi_1\eta_{23}\,.\,S\alpha\beta\gamma.$$

* The vector functions $\phi_3'\phi_2$ and $\phi_2'\phi_3$ are conjugate, since

$$S\lambda\phi_3'\phi_2\mu = S\phi_3\lambda\phi_2\mu = S\mu\phi_2'\phi_3\lambda.$$

The quaternion is, consequently, reduced to

$$q(\phi_1, \phi_2, \phi_3) = 2(\phi_1\eta_{23} - \phi_2\eta_{31} + \phi_3\eta_{12}) + l_3(\phi_1, \phi_2, \phi_3),$$

and is therefore, as has been announced, independent of the vectors α, β, and γ.

Occasionally, the vector $2\eta_{23}$ may be designated by

$$V(\phi_3'\phi_2 - \phi_2'\phi_3),$$

but care must be taken to distinguish between

$$\phi_1 V(\phi_3'\phi_2 - \phi_2'\phi_3) \cdot \rho = 2\phi_1\eta_{23} \cdot \rho,$$

and

$$\phi_1(\phi_3'\phi_2 - \phi_2'\phi_3)\rho = 2\phi_1 V\eta_{23}\rho.$$

7. *Special cases of this invariant.*—As a particular case of the preceding invariant, let $\phi_1 = \phi_3$, and then

$$q(\phi_1, \phi_2, \phi_1) = l_3(\phi_1, \phi_2, \phi_1).$$

For

$$\eta_{21} + \eta_{12} = 0, \quad \text{and} \quad \eta_{11} = 0,$$

and the vector part vanishes. This might have been predicted, from an example in Art. 5. If $\phi_2 = \phi_3$,

$$q(\phi_1, \phi_3, \phi_2) = l_3(\phi_1, \phi_2, \phi_2) + 4\phi_2\eta_{12};$$

hence, in particular, if $\phi_2 = 1$,

$$q(\phi_1, 1, 1) = l_3(\phi_1, 1, 1) + 4\epsilon_1;$$

in which expression, remembering that

$$2\eta_{12} = V(\phi_2'\phi_1 - \phi_1'\phi_2),$$

ϵ_1 is the spin-vector of ϕ_1.

Now,

$$l_3(\phi_1, 1, 1) = 2m_1 \quad \text{if} \quad \phi_1^3 - m_1\phi_1^2 + m_2\phi_1 - m_3 = 0,$$

and, therefore,

$$q(\phi_1, 1, 1) = 2(m_1 + 2\epsilon_1),$$

which is Hamilton's first invariant. Also, in a similar manner,

$$\begin{aligned} q(\phi_1, \phi_1, 1) &= l_3(\phi_1, \phi_1, 1) + 4\phi_1\epsilon_1 \\ &= 2(m_2 + 2\phi_1\epsilon_1); \end{aligned}$$

and this is Hamilton's second quaternion invariant.[1]

$q(\phi_1, \phi_1, \phi_1)$ is easily seen to be equal to $6m_3$.

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[1] See his "Elements of Quaternions," Art. 349.

8. ***On interchange of rows, six quaternion invariants are found; these are equivalent to one scalar, and three vector invariants.***—The effect of the interchange of rows was partially considered in the 5th Article. Closely connected with this is the effect of the interchange of ϕ_1, ϕ_2, and ϕ_3 in the invariant $q(\phi_1, \phi_2, \phi_2)$. In order to see the connexion, it is only necessary to remark, that if

$$\alpha_1 = \phi_1\alpha, \quad \alpha_2 = \phi_2\alpha, \quad \text{and} \quad \alpha_3 = \phi_3\alpha,$$

with similar meanings for β_1, β_2, β_3, and γ_1, γ_2, γ_3,

$$q(\phi_1, \phi_2, \phi_3)\,S\alpha\beta\gamma = \begin{vmatrix} \alpha_1 & \beta_1 & \gamma_1 \\ \alpha_2 & \beta_2 & \gamma_2 \\ \alpha_3 & \beta_3 & \gamma_3 \end{vmatrix}.$$

For brevity, let $l_3(\phi_1, \phi_2, \phi_3)$ be denoted by l_3, as in this scalar part transposition of the functions is without effect;[1] then

$$q(\phi_1, \phi_2, \phi_3) = l_3 + 2(\phi_1\eta_{23} - \phi_2\eta_{31} + \phi_3\eta_{12}),$$
$$q(\phi_2, \phi_2, \phi_1) = l_3 - 2(\phi_1\eta_{23} - \phi_2\eta_{31} + \phi_3\eta_{12});$$
$$q(\phi_3, \phi_3, \phi_1) = l_3 + 2(\phi_1\eta_{23} + \phi_2\eta_{31} - \phi_3\eta_{12}),$$
$$q(\phi_1, \phi_3, \phi_2) = l_3 - 2(\phi_1\eta_{23} + \phi_2\eta_{31} - \phi_3\eta_{12});$$

and

$$q(\phi_3, \phi_1, \phi_2) = l_3 + 2(-\phi_1\eta_{23} + \phi_3\eta_{31} + \phi_2\eta_{12}),$$
$$q(\phi_2, \phi_1, \phi_3) = l_3 - 2(-\phi_1\eta_{23} + \phi_3\eta_{31} + \phi_2\eta_{12}).$$

The quaternions are here grouped in conjugate pairs, and the six different values of determinants of the third order formed by the same three rows in different orders are exhibited.

9. *Relations connecting vector invariants. Two reducing formulæ.*—The six invariants lately considered are equivalent to one scalar and three vector invariants. I propose now to consider some reductions and relations concerning vector invariants.

Retaining the suffix notation, let ϵ_1 denote the spin-vector of ϕ_1, ϵ_2 that of ϕ_2, and ϵ_{12} and ϵ_{21} those of $\phi_1\phi_2$ and $\phi_2\phi_1$, respectively. Let ϕ_1 satisfy the cubic

$$\phi_1^3 - m_1\phi_1^2 + m_2\phi_1 - m_3 = 0,$$

and let ϕ_2 satisfy

$$\phi_2^3 - m_1'\phi_2^2 + m_2'\phi_2 - m_3' = 0.$$

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[1] This may be verified by expansion of the determinants, but it is otherwise obvious.

For an arbitrary vector ρ,

$$(\phi_1\phi_2 - \phi_2'\phi_1')\,\rho = [\phi_1' + (\phi_1 - \phi_1')]\,\phi_2\rho - \phi_2'\,[\phi_1 - (\phi_1 - \phi_1')]\,\rho$$

$$= (\phi_1'\phi_2 - \phi_2'\phi_1)\,\rho + 2\,V\epsilon_1\phi_2\rho + 2\phi_2'\,V\epsilon_1\rho$$

$$= 2\,V\eta_{21}\rho + 2\,(m_1'\,V\epsilon_1\rho - V\phi_2\epsilon_1\rho)\,;$$

using the fundamental relation

$$m_1'\,V\epsilon_1\rho = V\epsilon_1\phi_2\rho + V\phi_2\epsilon_1\rho + \phi_2'\,V\epsilon_1\rho,$$

and retaining the signification of η_{21}.

But ρ is arbitrary, and $(\phi_1\phi_2 - \phi_2'\phi_1')\,\rho = 2\,V\epsilon_{12}\rho$, and consequently,

$$\epsilon_{12} = -\,\eta_{12} + m_1'\epsilon_1 - \phi_2\epsilon_1.$$

Interchanging the functions ϕ_1 and ϕ_2, the similar relation

$$\epsilon_{21} = +\,\eta_{12} + m_1\epsilon_2 - \phi_1\epsilon_2$$

is found.

If $\phi_1 = \phi_2$, as a particular case of these relations

$$\tfrac{1}{2}\,V(\phi_1^2 - \phi_1'^2) = m_1\epsilon_1 - \phi_1\epsilon_1.$$

10. *On cyclical transposition of a product of functions.*—Adding the two relations found in the last Article,

$$\epsilon_{12} + \epsilon_{21} = m_1'\epsilon_1 + m_1\epsilon_2 - \phi_2\epsilon_1 - \phi_1\epsilon_2\,;$$

this formula will be found to be of importance in the reduction of the number of vector invariants. By its means the spin-vector of any function $\theta\phi$ may be expressed in terms of that of $\phi\theta$, and of the results of operation on the spin-vectors of θ and ϕ. More generally by repeated application of the formula, the spin-vectors of any cyclical group of functions such as $\phi^2\theta$, $\phi\theta\phi$, $\theta\phi^2$ (in which the symbols θ and ϕ are cyclically transposed) may be expressed in terms of the spin-vector of any one of the functions ($\phi^2\theta$ suppose) and in terms of the results of operation on the spin-vectors of simpler functions.

11. *When a square enters into the product, the spin-vectors are reducible.*—Replacing ϕ_2 by $\phi_2\phi_1$ in the first formulæ of Art. 9 (which may be written in the form

$$V(\phi_1\phi_2 - \phi_2'\phi_1') = V(\phi_1'\phi_2 - \phi_2'\phi_1) + m_1(\phi_2)\,.\,V(\phi_1 - \phi_1') - \phi_2\,V(\phi_1 - \phi_1'))$$

$$V(\phi_1\phi_2\phi_1 - \phi_1'\phi_2'\phi_1') = V(\phi_1'\phi_2\phi_1 - \phi_1'\phi_2'\phi_1)$$
$$+\,m_1(\phi_2\phi_1)\,V(\phi_1 - \phi_1') - \phi_2\phi_1\,V(\phi_1 - \phi_1')$$

is the result, $m_1(\phi_2\phi_1)$ denoting the m_1 invariant of $\phi_2\phi_1$.

Now $(\phi_1'\phi_2\phi_1 - \phi_1'\phi_2'\phi_1)\rho = \phi_1'(\phi_2 - \phi_2')\phi_1\rho$

$$= 2\phi_1' V\epsilon_2\phi_1\rho = 2m_3 V\phi_1^{-1}\epsilon_2\rho,$$

and therefore as ρ is arbitrary,

$$V(\phi_1'\phi_2\phi_1 - \phi_1'\phi_2'\phi_1) = 2m_3\phi_1^{-1}\epsilon_2 = 2(\phi_1^2 - m_1\phi_1 + m_2)\epsilon_2.$$

The spin-vector of $\phi_1'\phi_2\phi_1$ is consequently reduced to a result of operation on the spin-vector of ϕ_2.

To see the full bearing of this, observe that by a formula lately written,

$$V(\phi_1\phi_2\phi_1 - \phi_1'\phi_2'\phi_1') = 2m_3\phi_1^{-1}\epsilon_2 + 2m_1(\phi_2\phi_1).\epsilon_1 - 2\phi_2\phi_1\epsilon_1.$$

Thus the spin-vector of $\phi_1\phi_2\phi_1$ is likewise reduced to the results of operation on the spin-vectors of simpler functions, and therefore, by the last Article, the spin-vectors of $\phi_1^2\phi_2$ and $\phi_2\phi_1^2$ are similarly reducible. Generally, therefore, having formed from any number of functions ϕ a function $\Phi = \phi_1\phi_2\phi_3\phi_1\phi_4$ &c., the spin-vectors of all the functions formed by cyclically transposing the ϕ in Φ are, by the last Article, linearly and invariantally expressible in terms of the spin-vector of Φ, and in terms of the results of operation on the spin-vectors of simpler functions; and, by the present Article, if any one of the ϕ is consecutively repeated in Φ, the spin-vectors of the functions of the group are all expressible in terms of the results of operation on the spin-vectors of simpler functions.

12. *This is also the case when the same function occurs twice in the product.*—For two functions, ϕ_1 and ϕ_2, the vector invariants are the results of operation on the two spin-vectors ϵ_1 and ϵ_2, and on *one* of the three vectors ϵ_{12}, ϵ_{21}, and η_{12}. In this case the cyclical group consists of the functions $\phi_1\phi_2$ and $\phi_2\phi_1$. The group $\phi_1\phi_2\phi_1\phi_2$ gives a reducible invariant. Before proceeding to the consideration of three functions, another general formula of reduction will be given.

If θ and ψ are any linear vector functions, the vector invariants of the cycle $\phi_1\theta\phi_1\psi$ are reducible. A function of the cycle is $\psi\phi_1\theta\phi_1$ and

$$V(\psi\phi_1.\theta\phi_1 - \phi_1'\theta'.\phi_1'\psi') = V(\phi_1'\psi'.\theta\phi_1 - \phi_1'\theta'.\psi\phi_1)$$
$$+ m_1(\theta\phi_1)V(\psi\phi_1 - \phi_1'\psi') - \theta\phi_1 V(\psi\phi_1 - \phi_1'\psi'),$$

by a formula of Art. 9 or 11, the functions $\psi\phi_1$ and $\theta\phi_1$ replacing ϕ_1 and ϕ_2.

Now, as in the last article,

$$(\phi_1'\psi'.\theta\phi_1 - \phi_1'\theta'.\psi\phi_1)\rho = \phi_1'(\psi'\theta - \theta'\psi)\phi_1\rho$$
$$= m_3(\phi_1).V.\phi_1^{-1}V(\psi'\theta - \theta'\psi).\rho,$$

so $$V(\phi_1'\psi'.\theta\phi_1 - \phi_1'\theta'.\psi\phi_1) = m_3(\phi_1).\phi^{-1}V(\psi'\theta - \theta'\psi),$$

and the theorem just stated is proved.

Hence, for any number of functions, it is only necessary to consider the cycles in which no function occurs twice.

For three functions these cycles are to be derived from

$$\phi_2\phi_3,\ \phi_3\phi_1,\ \phi_1\phi_2;\ \phi_1\phi_2\phi_3 \text{ and } \phi_3\phi_2\phi_1.$$

13. *Search for new vector invariants may be limited to the consideration of spin-vectors.*—There is no difficulty in seeing that the vector parts of any of the quaternions

$$q\,(\phi_1\phi_2\phi_3,\ 1,\ 1),\quad q\,(\phi_2\phi_3,\ \phi_1,\ 1),\quad q\,(\phi_1,\ \phi_2,\ \phi_3),\quad \&c.,$$

are linear and invariant functions of the spin-vectors of the five cycles of the last article, and of the spin-vectors of ϕ_1, ϕ_2, and ϕ_3. The vectors involved in $q\,(\phi_2\phi_3,\ \phi_1,\ 1)$ are

$$V(\phi_1'\phi_2\phi_3 - \phi_3'\phi_2'\phi_1),\quad \phi_1 V(\phi_2\phi_3 - \phi_3'\phi_2'),\quad \text{and}\quad \phi_3\phi_2 V(\phi_1 - \phi_1').$$

The first of these is, by Art. 9, expressible in terms of

$$V(\phi_2\phi_3\phi_1 - \phi_1'\phi_3'\phi_2'),$$

and results of operation.

Hence, in searching for new vector invariants, it is legitimate to investigate the spin-vectors alone of the functions formed by multiplying the given functions together. There is no need to investigate separately the spin-vectors of products such as $\phi_1'\phi_2\phi_3$.

14. *Reducing systems of quaternion invariants.*—The "reducing systems" of the previous Paper may be used in the more general case of quaternion invariants. It is evident, from the constitution of these functions, that

$$\begin{aligned} xq\,(\psi_1\phi^2\psi_2,\ \psi_3,\ \psi_4) + yq\,(\psi_1\phi\psi_2,\ \psi_3,\ \psi_4) + zq\,(\psi_1\psi_2,\ \psi_3,\ \psi_4) \\ = q\,[\psi_1(x\phi^2 + y\phi + z)\,\psi_2,\ \psi_3,\ \psi_4], \end{aligned}$$

in which x, y, and z are scalars, and ϕ and the ψ linear vector functions. Now, as ϕ satisfies a cubic equation

$$\phi^3 - m_1\phi^2 + m_2\phi - m_3 = 0,$$

any rational algebraic function of ϕ may be reduced to the form

$$f(\phi) = x\phi^2 + y\phi + z,$$

and therefore

$$q\,(\psi_1 f(\phi)\,\psi_2,\ \psi_3,\ \psi_4)$$

is reducible in terms of three simpler quaternions.

15. *Locus of axes of $\phi_1 + t\phi_2$.*—A few properties of the system of linear vector functions $\phi_1 + t\phi_2$ may here be noticed. If g_1, g_2, and g_3 are the roots, and ρ_1, ρ_2, and ρ_3 the axes corresponding to a given value of t, the vector equation

$$\phi_1\rho + t\phi_2\rho = g\rho$$

is satisfied for $\rho = \rho_1$, and $g = g_1$, &c. Remembering that g_1 is a root of the cubic

$$g^3 - g^2 m_1(\phi_1 + t\phi_2) + g m_2(\phi_1 + t\phi_2) - m_3(\phi_1 + t\phi_2) = 0,$$

the vector equation denotes a cubic cone, the locus of axes of $\phi_1 + t\phi_2$; the scalar equation of this cone is

$$S\rho\phi_1\rho\phi_2\rho = 0 = f.$$

The locus of axes of the conjugate system $\phi_1' + t\phi_2'$ is given by

$$\phi_1'\rho + t\phi_2'\rho = g\rho, \quad \text{or by} \quad S\rho\phi_1'\rho\phi_2'\rho = 0 = f'.$$

If ρ_1' is the edge of the cone f', determined by t and g_1, it is at right angles to two edges ρ_2 and ρ_3 of the cone f which correspond to the same value of t; the vector $V\rho_1'\phi_1'\rho_1'$ or $V\rho_1'\phi_2'\rho_1'$ is the third edge of f at right angles to ρ_1'.*

Thus the reciprocal of the cone f' is the envelope of the principal planes of the system of functions $\phi_1 + t\phi_2$. This envelope being of the third class, through any line through the origin it is possible to draw three principal planes of the system of functions $\phi_1 + t\phi_2$.

Equating to zero the discriminant of the cubic in g, it appears that six functions of the system have double roots and coincident axes; for this discriminant is a sextic in t. The cone f being of the sixth class, and the reciprocal of f' of the third, eighteen principal planes of the system $\phi_1 + t\phi_2$ are tangent to f, as well as to the reciprocal of f'. Six of these planes evidently touch f along the six coincident axes, and the other twelve planes probably correspond to coincidence of ρ_2 (or of ρ_3) with $V\rho_1'\phi_1\rho_1'$.

The planes joining corresponding edges of the two cones (ρ_1, ρ_1'; ρ_2, ρ_2'; and ρ_3, ρ_3'), which answer to the same value of t, intersect on the orthocentric line

$$V(\epsilon_1 + t\epsilon_2)(\phi_1 + t\phi_2)(\epsilon_1 + t\epsilon_2).$$

As t varies, this line describes a cubic cone.

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* A particular case of this cone was considered in Art. 16 of my Paper on "The Scalar Invariants of Two Linear Vector Functions" (*loc. cit.*, p. 721).

In the particular case in which ϕ_1 and ϕ_2 are self-conjugate, the cones f and f' coincide, and every generator of the single cone is at right angles to two other generators likewise mutually perpendicular.

As a solid is strained from any configuration to any other by gradually increasing a strain of given type, the locus of the unrotated lines is a cubic cone.

16. *Homographic transformations.*—Not only is the cone $S\rho\phi_1\rho\phi_2\rho = 0$ the locus of axes of $\phi_1 + t\phi_2$, but it is also the locus of axes of the system of functions

$$(a\phi_1 + b\phi_2 + c)^{-1}(a'\phi_1 + b'\phi_2 + c'),$$

a, b, c, a', b', and c' being arbitrary scalars.

For the equation of the cone f may be written in the form

$$S(a\phi_1 + b\phi_2 + c)\rho\,(a'\phi_1 + b'\phi_2 + c')\rho\,(a''\phi_1 + b''\phi_2 + c'')\rho = 0,$$

and then in the form

$$S\rho(a\phi_1 + b\phi_2 + c)^{-1}(a'\phi_1 + b'\phi_2 + c')\rho(a\phi_1 + b\phi_2 + c)^{-1}(a''\phi_1 + b''\phi_2 + c'')\rho = 0,$$

or

$$S\rho\psi_1\rho\psi_2\rho = 0.$$

To each cone f corresponds an infinite number of cones f'. If

$$\psi_1 = (a\phi_1 + b\phi_2 + c)^{-1}(a'\phi_1 + b'\phi_2 + c'),$$

its conjugate is

$$\psi_1' = (a'\phi_1' + b'\phi_2' + c')(a\phi_1' + b\phi_2' + c)^{-1};$$

but now the cone corresponding to $f = S\rho\psi_1\rho\psi_2\rho = 0$, with respect to the functions ψ_1 and ψ_2, is $S\rho\psi_1'\rho\psi_2'\rho = 0$; and this cone is not the same as $S\rho\phi_1'\rho\phi_2'\rho = 0$, because $a'\phi_1' + b'\phi_2' + c'$ and $(a\phi_1' + b\phi_2' + c)^{-1}$ are not commutative in order of operation.

17. *Condition that two functions should be expressible in the form* $\Phi_3^{-1}\Phi_1$ *and* $\Phi_3^{-1}\Phi_2$.—Though an arbitrary cubic cone may be written in the form $S\Phi_1\rho\Phi_2\rho\Phi_3\rho = 0$, in which the Φ are self-conjugate functions, it is not generally possible to express two functions by the relations $\phi_1 = \Phi_3^{-1}\Phi_1$ and $\phi_2 = \Phi_3^{-1}\Phi_2$. If ρ_1, ρ_2, and ρ_3 are the axes of ϕ_1, and g_1, g_2, and g_3 its roots, then, if $\phi_1 = \Phi_3^{-1}\Phi_1$,

$$\Phi_1\rho_1 = g_1\Phi_3\rho_1 = x_1 g_1 V\rho_2\rho_3,$$

$$\Phi_1\rho_2 = g_2\Phi_3\rho_2 = x_2 g_2 V\rho_3\rho_1,$$

and

$$\Phi_1\rho_3 = g_3\Phi_3\rho_3 = x_3 g_3 V\rho_1\rho_2.$$

To prove these relations, observe that

$$g_3 S\rho_2\Phi_3\rho_3 = S\rho_2\Phi_1\rho_3 = S\rho_3\Phi_1\rho_2 = g_2 S\rho_3\Phi_3\rho_2\,;$$

and therefore, as Φ_1 and Φ_3 are self-conjugate,

$$S\rho_2\Phi_3\rho_3 = S\rho_3\Phi_3\rho_1 = S\rho_1\Phi_3\rho_2 = 0,$$

and

$$S\rho_2\Phi_1\rho_3 = S\rho_3\Phi_1\rho_1 = S\rho_1\Phi_1\rho_2 = 0,$$

provided the roots g_1, g_2, and g_3 are unequal.

It appears, therefore, that the axes of ϕ_1 are a self-conjugate triad of lines with respect to the two cones $S\rho\Phi_1\rho = 0$ and $S\rho\Phi_3\rho = 0$.

If, in addition, $\phi_2 = \Phi_3^{-1}\Phi_2$, the axes of ϕ_2 would also be a self-conjugate triad with respect to $S\rho\Phi_3\rho = 0$; but if two triads of lines are self-conjugate to the same quadric cone, both triads must lie on a quadric cone.[1] The condition is, therefore, the axes of ϕ_1 and ϕ_2 must lie on a quadric cone.

Returning to the functions Φ_1 and Φ_3, since

$$V\rho_1\Phi_1\rho_1 = g_1 V\rho_1\Phi_3\rho_1 = x_1 g_1 V\rho_1 V\rho_2\rho_3 \parallel (\phi_1 - g_1)\epsilon_1,$$

the axes of ϕ_1 lie on the quadric cone $SV\rho\Phi_1\rho V\epsilon_1\phi_1\epsilon_1 = 0$. This cone contains also the axes of Φ_1, and, by a little manipulation, its equation may be thrown into the form $SV\rho\phi_1\rho V\epsilon_1\Phi_1\epsilon_1 = 0$. In like manner, the axes of Φ_3 lie on the cone

$$SV\rho\phi_1\rho V\epsilon_1\Phi_3\epsilon_1 = 0.$$

18. *Triads of lines in perspective with their derived triads.*—Generally the locus of lines ρ, any one of which is coplanar with its derived line $\phi_1\rho$ and a fixed vector a, is the quadric cone $S\rho\phi_1\rho a = 0$. If this cone contains a triad of mutually rectangular lines i, j, and k,

$$Sa\Sigma Vi\phi_1 i = 0, \quad \text{or} \quad Sa\epsilon_1 = 0.$$

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[1] If the triangle, the coordinates of whose vertices are x_1, y_1, z_1; x_2, y_2, z_2; and x_3, y_3, z_3, is self-conjugate with respect to

$$ax^2 + by^2 + cz^2 = 0; \quad ax_2x_3 + by_2y_3 + cz_2z_3 = 0, \quad \text{\&c.},$$

and therefore

$$\begin{vmatrix} \dfrac{1}{x_1} & \dfrac{1}{y_1} & \dfrac{1}{z_1} \\[2ex] \dfrac{1}{x_2} & \dfrac{1}{y_2} & \dfrac{1}{z_2} \\[2ex] \dfrac{1}{x_3} & \dfrac{1}{y_3} & \dfrac{1}{z_3} \end{vmatrix} = 0.$$

If three lines are in perspective with their derived lines, and if a is the axis of perspective, the lines lie on the cone $S\rho\phi_1\rho a = 0$. This furnishes an interpretation of the vanishing of the skew scalar invariant $N_3' - N_3$, in Art. 19 of the Paper on Scalar Invariants. In the notation of that article, if ρ_1, ρ_2, and ρ_3 are the axes of ϕ, and if

$$\theta\rho_1 = a_{11}\rho_1 + a_{12}\rho_2 + a_{13}\rho_3, \text{ \&c.,} \quad V\rho_1\theta\rho_1 = a_{12}V\rho_1\rho_2 + a_{13}V\rho_1\rho_3,$$

and

$$SV\rho_1\theta\rho_1 V\rho_2\theta\rho_2 V\rho_3\theta\rho_3 = (a_{12}a_{23}a_{31} - a_{21}a_{32}a_{13})\, SV\rho_2\rho_3 V\rho_3\rho_1 V\rho_1\rho_2.$$

The skew invariant consequently vanishes, if the derived lines of the axes of either vector function with respect to the other function are in perspective with them.

Finally, it may be noticed, that if β is an arbitrary vector, the locus of axes of the functions $\phi_1\rho + aS\beta\rho$ is the quadric cone $S\rho\phi_1\rho a = 0$.

19.—*Co-residual property.*—The axis of the functions $\phi_1 + t\phi_2$ are all co-residual triads of lines on the cubic cone. For the four lines common to the cone

$$SaV\rho(\phi_1 + t\phi_2)\rho = 0$$

(which contains the axes of $\phi_1 + t\phi_2$), and to the cone $SaV\rho\phi_1\rho = 0$, satisfy the equation

$$xa = V.\, V\rho\phi_1\rho V\rho(\phi_1 + t\phi_2)\rho$$
$$= -\, t\rho S\rho\phi_1\rho\phi_2\rho.$$

Three of the lines are therefore on the cone $S\rho\phi_1\rho\phi_2\rho = 0$, and are variable with a, but independent of t. The fourth line is, of course, a. The three lines common to the cubic, and $Sa\rho\phi_1\rho = 0$ are therefore residual to every triad of axes.

If the elliptic parameters of the axes of $\phi_1 + t\phi_2$ are u_1, u_2, and u_3, their sum is constant, or

$$u_1 + u_2 + u_3 = u_0.$$

Unless, therefore, u_0 is equal to half a *period*, the axes of two functions $\phi_1 + t\phi_2$ and $\phi_1 + t'\phi_2$ will not lie on a quadric cone.

Again, the four lines common to the quadric cones satisfy

$$x\rho = V.\, Va\phi_1\rho\, Va\phi_2\rho$$
$$= -\, aSa\phi_1\rho\phi_2\rho.$$

Consequently, the three edges which lie on the cubic lie also on the new quadric

$$Sa\phi_1\rho\phi_2\rho = 0.$$

But the equation of this cone may be written in either of the forms

$$S\phi_1^{-1}\alpha V\rho\phi_1^{-1}\phi_2\rho = 0, \quad \text{or} \quad S\phi_2^{-1}\alpha V\rho\phi_2^{-1}\phi_1\rho = 0;$$

and therefore the axes of $\phi_1^{-1}\phi_2$ (or of its reciprocal $\phi_2^{-1}\phi_1$) also lie on it, and are the three residual lines in which it cuts the cubic.

More generally, the equations of the quadric cones combine into

$$S\alpha V\rho\,(a\phi_1 + b\phi_2 + c)\,\rho = 0, \quad \text{and} \quad S\alpha V\rho\,(a'\phi_1 + b'\phi_2 + c')\,\rho = 0;$$

and, as before, their three lines of common intersection with the cubic lie on the cone

$$S\alpha\,(a\phi_1 + b\phi_2 + c)\rho\,(a'\phi_1 + b'\phi_2 + c')\rho = 0.$$

This equation, being thrown into the form

$$S\,(a\phi_1 + b\phi_2 + c)^{-1}\alpha V\rho(a\phi_1 + b\phi_2 + c)^{-1}(a'\phi_1 + b'\phi_2 + c')\rho = 0,$$

shows that the axes of all the functions of the type

$$(a\phi_1 + b\phi_2 + c)^{-1}(a'\phi_1 + b'\phi_2 + c')$$

are co-residual triads on the cubic cone.

II.

PREHISTORIC CENOTAPHS. By GEORGE COFFEY, B.E.

[Read November 11, 1895.]

Should grave-mounds in which no remains of interment have been found be regarded as cenotaphs, is a subject that has been much discussed. Canon Greenwell rejected the existence of such monuments in his work on British Barrows. He writes:—

"Barrows are sometimes met with in which, upon examination, no burial appears to have taken place, since no remains of the body are to be discovered. In the greater number of these instances there can be little doubt that, in consequence of the imperfect exploration of the mound, the place of burial has been missed, and in other cases that a small deposit of burnt bones or the almost entirely decayed bones of an unburnt body have been overlooked. . . . But there are other cases, and such have occurred to myself, when the most careful examination has failed to discover any trace of an interment. These empty barrows have been spoken of as cenotaphs, monuments raised to commemorate but not to contain the dead. Mr. Kemble, holding the view that barrows were prepared beforehand, and that, from time to time, bodies were inserted in the mounds so set apart, believed that the barrows where no burials are found had never been used for interment. Neither of these views appears to be a tenable one, and both seem modes of accounting for the absence of burials much too artificial for such a state of society as may be supposed to have existed during the ages when barrow burial was in use in Britain. With every wish to defer to the great practical knowledge of Mr. Kemble, as well as to the skill with which, as a rule, his mind moulded the facts he had accumulated into a consistent and reasonable theory, I cannot but regard this opinion as being both unnatural and out of harmony with the general mass of evidence which the burial mounds afford. Nor do I see any difficulty in accounting for the absence of bones or other indications of an interment where a careful examination has shown that such evidence has not been overlooked through a careless or imperfect exploration. In the greater number

of instances, however, as has already been stated, the barrows are found empty, not because they are so in reality, but because they have not been searched exhaustively. The absence of any signs of a burial, where a barrow has been minutely and fully examined, is due, in my opinion, to the entire decay of the skeleton, in cases where no weapon, implement, ornament, or vase has accompanied the body."[1]

Again, under Barrow XLVII., Canon Greenwell writes:—

"It was the most perplexing barrow I have ever met with; and but for my complete disbelief that monuments of a more artificial age, such as cenotaphs, had any existence during the era of these burial mounds, I should feel that it offers a problem very difficult to solve on any other supposition."[2]

More recent researches in the barrows of the North of England (*Archæologia,* 1890) have induced Canon Greenwell to modify his position. He now reluctantly admits the possibility of cenotaphs. This change of opinion is based on the result of the exploration of the barrow called "Willie Howe," in the East Riding of Yorkshire. Concerning this barrow he writes—

"Throughout the whole course of my barrow explorations I have never met with anything that I can compare with this mound. It was of more than ordinary size, and constructed at the expense of much labour, well proportioned and symmetrically made, and in every way appeared to have been intended for a place of sepulture. Beneath it at the centre was a deep excavation in the solid chalk rock, in which were found remains of animal bones almost as sound as when they were deposited, a condition which would have equally been incidental to human bones. No disturbance had ever taken place within the grave to account for the disappearance of the body or its accompanying relics, and it is almost impossible to believe that an interment had ever been made in it. I can attempt no explanation of the very peculiar features here manifested, except one which I have arrived at with great reluctance. Until I opened Willie Howe I had always disbelieved in the erection of such memorials as cenotaphs at the time when these barrows were constructed. That supposition appears, however, to be countenanced by the experience of this mound, and I am forced to admit the possibility that this very large mass of chalk stones was thrown up merely to commemorate, and not to contain, the body of some great personage. There is still a difficulty which this

[1] British Barrows, page 27. [2] *l. c.*, page 202. See also Barrows XCI. and CXXIX.

explanation does not remove. If it is admitted that a mound like this might be raised merely as a memorial, that does not explain why beneath it a deep excavation should have been made. On more than one previous occasion I have found mounds apparently sepulchral, which proved to be entirely wanting in any signs of an interment. I came to the conclusion in these cases, though it was sometimes difficult to admit it, that the bones had gone entirely to decay, leaving no trace behind them. It is possible, however, that in these mounds, as in the case of Willie Howe, there had never been any burial within them; and that they, equally with this in question, were memorial and not sepulchral."[1]

Canon Greenwell's position may be described as the admission of a negative possibility. Speaking generally, the present state of the question appears to be that cenotaphs are not yet accepted in prehistoric archæology, though individual archæologists support that explanation of barrows in which interments have not been made.[2]

The hesitation of archæologists to recognize such barrows as cenotaphs appears to be due to a misconception of the essential idea of the cenotaph.

This is evident in the extracts quoted from Canon Greenwell, who speaks of such monuments as memorials, whereas they are, in primitive logic, true tombs. This point appears to be recognized by Dr. Naue in the passage quoted in the note below.

The error prevails owing to the fact that, as far as I am aware, no attempt has hitherto been made to combine the archæological with the anthropological evidence on the subject. When we do so, it becomes evident that it would be more difficult to account for the absence of cenotaphs from the remains of a barrow-raising people than their presence.

Before, however, proceeding with this portion of the subject, it is desirable to further develop the archæological evidence on the question.

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[1] "Recent researches in the Barrows in Yorkshire, Wiltshire, Berkshire, &c." Archæologia (1890), vol. 52, p. 24.

[2] For instance, Handelmann, "Les Tumulus et les Cénotaphes de l'Âge du Bronze dans l'Île de Sylt," "Cong. Préhist." Stockholm, vol. i., p. 516; Naue, "Quelques tumulus, la plupart très bien construits, n'ont donné aucun objet—tout au plus, et très rarement, quelques traces de charbons. Je les considère comme des cénotaphes, tombes de hauts personnages de la tribu décédés au loin et dont on n'avait pu recouvrer les corps." "L'Époque de Hallstatt en Bavière," Revue Archéologique, 3 S., vol. xxvii. (1895), p. 46.

One of the most conclusive examples of a prehistoric cenotaph, probably the most conclusive, occurs in Ireland. It is the principal cairn in the prehistoric cemetery on the Loughcrew Hills, Co. Meath. The remains of twenty-eight cairns can still be counted in this important cemetery. The larger cairns are chambered, and in most cases have well-defined passages leading to the chambers. They are surrounded at the base by a curb of large stones laid end to end, within which the cairn is heaped, and the construction is in all such cases well and clearly defined. In the two largest of the chambered cairns, "L" and "T," the boundary stones are sharply curved in at the entrances, so that the entrances are clearly marked on the circle of the boundary stones.[1] This feature may be also seen in the great tumulus of New Grange, but it is more strongly marked at Loughcrew. Cairn "L" is 135 feet in diameter, and the entire length of passage and chamber measures 29 feet: Cairn "T," 115 feet in diameter, and passage and chamber, 28 feet.

These, as stated, are the largest chambered cairns, but they are exceeded by the dimensions of the unchambered Cairn "D," the largest in the cemetery, which reaches 180 feet in diameter.

This cairn is surrounded by a precisely similar curb of great stones, which likewise is curved-in apparently to mark an entrance to the cairn.

It is important to note the bearings of the passages to the chambered cairns in the cemetery.

In ten cases with well marked passages, they are given by Conwell as follows:—

Cairn	F.	E.	10, N.
,,	H.	E.	10, S.
,,	I.	E.	
,,	J.	E.	10, S.
,,	K.	E.	15, N.
,,	L.	E.	20, S.
,,	S.	W.	10, N.
,,	T.	E.	10, S.
,,	U.	E.	20, S.
,,	V.	E.	20, S.

Thus, with the exception of S., the passage of which faces west,

[1] The references are to Conwell's "Discovery of the Tomb of Ollamh Fodhla," Dublin, M'Glashan & Gill, 1873; a somewhat romantic essay, but reliable for descriptive details. I have checked the descriptions and measurements on the ground.

the bearings of the passages of these cairns lie between E. 15, N. and E. 20, S. In the cases of "L" and "T," where in addition to the passages the entrance is marked by the curving-in of the boundary stones, the bearings are E. 20, S. and E. 10, S.

Returning now to Cairn "D," I quote Conwell's description of the cairn and account of its excavation in the years 1865–68 :—

"This has been the largest of all the cairns in the range, the diameter of the base being 60 yards. The north and east sides have been left untouched; but on the south and west for nearly 100 yards round the base, and extending inwards to a distance of 24 yards from the circumference towards the centre, the dry loose stones comprising the cairn have been entirely removed. The height of what remained of the cairn, before commencing any of the operations upon it, measured 28 paces in sloping ascent from the base to the summit. The original circle of fifty-four large flag-stones laid on edge round its base is still perfect, and on the eastern side these marginal stones curve inwards for twelve paces in length towards a point indicated by E. 20, S., denoting where the entrance or passage to the interior chambers is to be found. As the cairn at this point—which, judging from the analogy in the construction of the other cairns, would indicate the direction of the passage or entrance—appeared not to have been previously disturbed, Mr. Naper and Mr. Hamilton had from the first strong hopes of finding the interior chambers and their contents in their original state, such exactly as they had been left in by the builders of this megalithic pile. Accordingly, on Monday morning, 4th September, 1865, about a dozen labouring men commenced to remove the stones, and to make a passage inwards from this point. As they advanced in this way into the cairn, the loose stones composing it occasionally fell in dangerous masses, filling up excavations already made; so that it was at length determined to make a cutting right through the cairn, running east and west, and commencing from the top. After two weeks spent in this labour, and with as many men as could be conveniently engaged at it, we did not come upon any of the interior chambers; nor have our labours been more successful on the 3rd, 4th, 5th, 6th, 8th, 9th, and 10th June, 1868, when, by Mr. Naper's directions twenty men were busily engaged every day in continuing the transverse cutting through the cairn, in search of the interior chambers. This, however, is now the only one of all the cairns left unexamined; and as the surface level of the ground has been already reached for the greater part of the way across the cairn, very little additional labour would be required to settle the question whether or

not this is a 'Blind tope.' As the cutting proceeded, about midway down among the loose stones, were found portions of the skulls, teeth, and other bones of graminivorous animals, probably the ox and deer."[1]

We have here a most interesting group of facts. It may be set down as certain that no chambers were contained in the portion of the cairn that had been removed on the south and west sides prior to Conwell's excavations. The stones removed from that part of the cairn were probably used to build the neighbouring fence walls. The large stones round the base have been left untouched, and within the cleared space there are no signs whatever of large stones such as would have formed the chamber. Had such existed, they would not have been broken up, as the loose stones of the cairn presented plenty of suitable material ready to hand.

Not only are the large stones at the base still there, but the curve has not been disturbed, the circle of the base is still clearly and regularly marked by them. There is no indication on this curve of an entrance at the cleared side. On the other hand, an entrance is clearly marked on the boundary stones at the east side at a point E. 20, S., which corresponds with the points of entrance to the majority of the chambered cairns. Following up this apparent entrance, not only was no trace of an interment found, but no indication of passage or chamber stones. In the other large cairns the passages and chambers are formed of large stones, and no attempt at concealment is made.

It is improbable that any interments exist in the unexplored portion of the cairn, and, if any were found, it would be necessary to look on them as secondary interments; they could in no case be regarded as the primary object for which the cairn was erected.

We have, then, the case of a cairn which to all outward appearance is a chambered cairn, with the entrance properly marked on it at the expected point, precisely similar to cairns "L" and "T," but which proves, on investigation, to be devoid of passage and chamber, to be in fact a blind tomb. In this respect it is, I think, even more conclusive than Willie Howe, as in its outward construction it would appear that a sepulchral purpose is intentionally simulated.

We may now consider the anthropological evidence. The idea of the cenotaph, we shall find, so far from being artificial, in the sense of modern or advanced civilization, is essentially primitive. It is, in fact, intimately related to the primitive theory of the soul.

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[1] "Ollamh Fodhla," Cairn "D."

In a most interesting Paper on "Certain Burial Customs as illustrative of the Primitive Theory of the Soul," Mr. J. G. Frazer has brought together a host of facts on this subject, from which I summarize the following particulars, referring the reader to the original Paper for authorities[1]:—

The belief is general that the ghosts of the unburied dead haunt the earth. But burial by itself was not sufficient to guard against the return of the ghost. Many precautions were taken by primitive man for the purpose of excluding or barring the dead from the living. Mr. Frazer recounts many customs for the purpose of chasing away the ghost from his late home or barring his return thereto. Some plans of keeping a ghost down are: to nail the dead man to the coffin (the Chuwashé), to tie the feet together (among the Arabs), or hands together (in Voigtland), or neck to legs (among the Troglodytes, Damaras, and New Zealanders). The Wallachians drive a long nail through the skull, and lay a thorny stem of a wild rosebush on the shroud. The Californians and Damaras break the spine.[2] The ghost of a suicide has always been looked on as especially dangerous, hence the custom of driving a stake through the body, and other customs of similar import.[3]

"But," as Mr. Frazer asks, "what happened when the body could not be found, as when the man died at sea or abroad? Here the all-important question was, What could be done to lay the wandering ghost? For wander he would till his body was safe under the sod, and by supposition his body was not to be found. The case was a difficult one, but early man was equal to it. He buried the missing man in effigy, and, according to all the laws of primitive logic, an effigy is every bit as good as its original."[4]

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[1] Journal Anthopological Institute, Great Britain and Ireland, vol. xv., p. 64.

[2] Miss Florence Peacocke, who has collected burial customs in Lincolnshire, states that skulls are at times dug up with iron nails hammered through them: about 1843 a skull was dug up in Messingham Churchyard with a nail through it, and on the authority of "Bygone Lincolnshire" (Ed. by Wm. Andrews)—"That the 'Layer-out' in some places ties together the feet of the corpse, but it is necessary that they should be unloosed before the coffin is screwed down, or else the dead will not rise at the first resurrection."—"The Antiquary," November, 1895.

[3] The general subject of the relations of the ghost to the body may be pursued in Tylor's "Primitive Culture," Frazer's "Golden Bough," W. Crooke's "Introduction to the Popular Religions and Folk-lore of Northern India," and the publications of the Bureau of Ethnology of the Smithsonian Institution.

[4] Frazer, *l. c.*, p. 95.

A few illustrations which I extract, with references, from a lengthy note to this statement, will make it clearer.

In ancient Mexico, when a trader died in a far country, the relations at home made a puppet of candlewood, adorned it with the usual paper ornaments, mourned over, burnt it, and buried the ashes in the usual way. Similarly soldiers who fell in battle were buried in effigy (Bancroft, *Native Races*, ii., pp. 616, *seq.*). In Samoa the relations spread out a sheet on the beach near where the man had been drowned, or on the battle-field where he had fallen; they then prayed, and the first thing that lighted on the sheet (grasshopper, butterfly, or whatever it might be) was supposed to contain the soul of the deceased, and was buried with all due ceremony (Turner, *Samoa*, pp. 150, *seq.*). The Garuda-purāna directs that "if a man dies in a remote place, or is killed by robbers in a forest, and his body is not found, his son should make an effigy of the deceased with Kusa grass, and then burn it on a funeral pile" with the usual ceremonies (Monier Williams, *Religious Thought and Life in India*, p. 300).[1] In China, during the reign of the Emperor Chan-tuk, in the first century of the Christian era, it was enacted that if the bodies of soldiers who fall in battle, or those of sailors who fall in naval engagements, cannot be recovered, the spirits of such men shall be called back by prayers and incantations, and that figures shall be made either of paper or of wood for their reception, and be burned with all the ordinary rites. . . . The custom is now universally observed" (Gray, *China*, i., pp. 295, *seq.*).

In Madagascar, cenotaphs are erected for those whose bodies cannot be found, and their ghosts are supposed to be allured thither (Ellis, *History of Madagascar*, i., p. 255).

Writers, who describe the burial customs of primitive peoples, rarely mention the case where the body is missing. I have looked through Herbert Spencer's *Descriptive Sociology*, and the only instances given there are those from Mexico and Madagascar quoted above.

The publications of the Bureau of Ethnology of the Smithsonian Institution, which describe so fully the customs of the native races of America, are silent on this point. Mr. Frazer appears, in fact, to be the only writer who has directed special attention to this branch of burial customs. Yet the case of a missing body must have been provided for wherever importance was attached to burial. At the

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[1] See also W. Crooke's "Popular Religion and Folk-lore of Northern India," p. 231.

present day funeral customs in use in many parts of Europe point, in survivals, to the widespread recognition by primitive man of the importance of providing for such cases. Mr. Frazer cites, amongst others, the following instances:—In modern Greece, when a man dies abroad, a puppet is made in his likeness, and dressed in his clothes, and mourning is made over it; it is not stated that the puppet is buried. In Albania, when a man dies abroad, all the usual lamentations are made at home, as if the body were present; the funeral procession goes to the church, but, in the place of the bier, a boy walks, carrying a dish on which a cracknel is placed over some boiled wheat. This dish is set in the middle of the church, and the funeral service is held over it; it is not, however, buried, but the women go and weep at the grave of the relation who died last.[1]

Dr. C. R. Browne, M.R.I.A., informs me that in the islands of Aran and in Innisboffin the usual wake is held in the case of a drowned person whose body has not been recovered. Wakes are likewise held on receipt of the news of a death abroad.

Information as to the manner in which primitive peoples provide for the case of a missing body is scanty, apparently because it has not been looked for, but the examples given are sufficient for our purpose.

They enable us to understand the essential meaning of the cenotaph to the Greeks and the Romans, which has been obscured by the modern association of the idea of memorial, and render available the large body of evidence which may be gathered from classical writers.[2]

The primitive theory of the relation of the soul, or ghost, to the body is at the bottom of the burial customs of the Greeks and the Romans. The same range of ideas, which we find in primitive man, are clearly present.

The importance attached by the Greeks and the Romans to burial need not be insisted on. The ghost of the unburied might not enter Hades, but must perforce wander till burial was given to the body.

Thus, in the *Iliad*, Patroclus reproaches Achilles for neglecting to give him burial:—"Bury me with all speed, that I pass the gates of Hades. Far off the spirits banish me, the phantoms of men outworn, nor suffer me to mingle with them beyond the river, but vainly I wander along the wide-gated dwelling of Hades" (xxiii., 71). The description of the unburied dead, and the appeal of Palinurus to Æneas in the *Æneid*, may be also instanced (vi., 295–415).

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[1] Frazer, *l. c.*, p. 96.

[2] Cenotaphs are treated as memorial in Smith's and in Seyffert's (ed. by Nettleship and Sandys) Dictionaries of Classical Antiquities.

The notion that the ghost was a double of the body, and that injury to or mutilation of the body took effect likewise on the ghost, is apparent in the description given in the *Æneid* of Deiphobus in Hades, "with all his body mutilated" (vi. 494).

It may be compared with the belief recorded of the Indians of Brazil, "that the dead arrive in the other world wounded or hacked to pieces, in fact, just as they left this."[1]

From, no doubt, a similar belief, in this case to render the ghost harmless, Greek murderers used to hack off the extremities of their victims.[2] This latter instance is compared by Mr. Frazer with the practice among the Australians of cutting off the thumb of a slain enemy, so that the ghost might not be able to throw the spear.[3] The same idea may be traced in the practice at Athens of cutting off the right hand of suicides.[4]

It has not been possible within the limits of the present Paper to do more than indicate, by a few striking examples, the general notion underlying the Greek and Roman theory of the ghost.

These examples show, however, that in Greek and Roman burial customs we are brought face to face with the same primitive conceptions concerning the relations of the ghost to the body which are found widely distributed among primitive peoples, and which, indeed, still survive among advanced peoples to an extent not generally suspected.

This wider aspect of the subject has been touched on, in order that the reader may more fully realize the force of the direct evidence of the cenotaphs which we shall now discuss.

The erection of cenotaphs is frequently mentioned by the Greek writers. Throughout Greece, when the relatives had not the body of the deceased, they erected cenotaphs, which were entitled to the same respect as true tombs.[5]

That the idea of such monuments is burial, and not memorial, may be gathered from the following illustrations:—

When Athene urges Telemachus to seek for his father, she adds: "But if thou shalt hear that he is dead and gone, return then to

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[1] Tylor, "Primitive Culture," i., 451.

[2] Aeschylus, "Choephori," 439: Sophocles, "Electra," 445—see the scholia on this verse, Jebb's "Electra," Appendix.

[3] Tylor, "Primitive Culture," i., 451.

[4] Daremberg and Saglio's "Dictionnaire des Antiquités Grecques et Romaines," "Funus," p. 1370.

[5] *Ibid.*, p. 1370.

thine own dear country and pile his mound, and over it pay burial rites, full many as is due."—

σῆμά τέ οἱ χεῦαι καὶ ἐπὶ κτέρεα κτερεΐξαι
πολλὰ μάλ', ὅσσα ἔοικε. . . . (*Od.* I. 291.)

Xenophon describes the burial of the dead after the battle of Calpe: "As the victims were favourable, the Arcadians also accompanied him, and buried the greatest part of the dead where they had severally fallen; for they had now lain five days, and it was no longer possible to bring them away; some of them, however, they gathered together out of the roads, and buried as becomingly as they could with the means at their command; while for those they could not find they erected a large cenotaph [with a great funeral pile], and put garlands upon it": οὓς δὲ μὴ εὕρισκον κενοτάφιον αὐτοῖς ἐποίησαν μέγα [καὶ πυρὰν μεγάλην] καὶ στεφάνους ἐπέθεσαν (vi. 4. 9).[1]

In the description in Thucydides of the funeral ceremonies of the Athenians who fell in the first year of the Peloponnesian war there is no mention of cenotaphs, but the underlying idea of the performance of the burial rites of the missing is clearly indicated.

"When the actual procession takes place, waggons carry coffins of cypress-wood, one for each tribe. In them are the bones of the tribe to which each individual belongs. One bier is borne empty, fully furnished forth, for the missing who had not been discovered at the taking up of the dead."—μία δὲ κλίνη κενὴ φέρεται 'εστρωμένη τῶν ἀφανῶν, οἳ ἂν μὴ εὑρεθῶσιν εἰς ἀναίρεσιν. (II. 34.)

M. Edward Cuq, in the article "Funus" in Daremberg and Saglio's *Dictionnaire des Antiquités*, has collected the sense of a number of passages on cenotaphs from Roman writers. His statement so fully covers the ground, it will be sufficient to quote the passage, referring the reader, for authorities, to the notes there given:

"Si le corps n'a pu être retrouvé, la sépulture n'est que 'imaginaire,' et le tombeau porte le nom de cénotaphe (*cenotaphium*). La construction des cénotaphes était due à cette croyance que l'âme détachée du corps avait besoin d'une demeure. Si on ne lui donnait un tombeau pour asile, elle errait sans trêve ni repos, comme un génie

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[1] The words καὶ πυρὰν μεγάλην are omitted in three good MSS.; they are retained in two good MSS., and in all the inferior ones. They are retained by Dindorf, but rejected by Zeune and others. Zeune remarks that he never heard of a funeral pile being erected in conjunction with a cenotaph. When the sepulchral nature of the cenotaph is understood, it is seen that the intrinsic evidence of the passage supports their retention.

malfaisant. Aussi, dès que le cénotaphe était terminé, appelait-on par trois fois l'âme du défunt pour l'inviter à entrer dans la demeure qui lui était préparée.

"Les cénotaphes étaient affectés principalement à ceux qui avaient péri en mer ou en temps de guerre. Un monument de ce genre fut construit par Germanicus, pour les âmes des soldats des légions de Varus. Le cénotaphe était donc un *inane bustum*, un *vacuum sepulcrum* et la sépulture était *inanis*.

"Il y avait une autre espèce de cénotaphe érigé en mémoire d'un défunt inhumé ailleurs : c'était un *honorarium sepulcrum*. Tel fut le monument construit pour Drusus, sur les bords du Rhin, par les soldats placés sous ses ordres, tandis que son corps, transporté à Rome, était inhumé au Champ de Mars. Le christianisme a conservé l'usage de ces cénotaphes, qui furent érigés en l'honneur des saints.

"De ces deux sortes de cénotaphes, la première a le caractère d'un *locus religiosus*, mais non la seconde. Telle est la décision d'un rescrit de Marc-Aurèle et Verus, rapporté par Ulpien."[1]

The sepulchral character of the cenotaph, and its relation to the primitive theory of the ghost, has now been sufficiently established.[2] In the grave-goods, weapons, "food-vessels," &c., accompanying prehistoric interments, we have evidence of the existence of the same fundamental conception of the ghost as a double of the body, which underlies the theory of the cenotaph, and it seems the natural conclusion that the empty barrows are cenotaphs. But fortunately I am able to relate the evidence collected in this Paper directly to Ireland, and thus close, at least for Ireland, the chain of evidence on the subject.

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[1] "Funus," p. 1396.

[2] We should perhaps recognise the possibility of some cenotaphs being what may be described as fictitious cenotaphs. That is to say, where the deceased has been buried abroad, a monument might be erected in his own country, not as a memorial, but to give his shade a dwelling amongst his own people. The case mentioned by Bancroft of a trader dying abroad perhaps is of this class. The cenotaph (tumulum inanem) erected by Andromache in Epirus for Hector (buried elsewhere), at which she made yearly offerings and "called on Hector's spirit" ("Æneid," III. 300), is also in point. It is conceivable that a people migrating from one country to another might erect tombs to their hero ancestors in the new country, so that their shades might dwell among them in their new home. There is no evidence that this was done, but the idea seems to be within the range of primitive logic. Cenotaphs such as Cairn D, the most important cairn in the cemetery at Loughcrew, appear to require some such explanation. In any case the suggestion is worth throwing out as indicating a direction in which evidence may be looked for.

The *Agallamh na Senórach*, or Colloquy with the Ancients, translated by Mr. Standish H. O'Grady, from the *Book of Lismore*, a MS. of the 15th century, is a topographical tract somewhat after the manner of the Dindsenchus, but cast in narrative form. It is, like the Dindsenchus, an invaluable store of ancient lore concerning glens, hills, lochs, raths, and burial mounds. In some instances the opening of grave-mounds and taking therefrom of weapons and gold is recounted.

The following story, which I extract in full (page 236), is of especial interest, as direct evidence of a tradition of the erection of cenotaphs in the heroic age in Ireland:—

"'Caeilte,' said the King of Munster, 'what are these two great graves that we see?' 'The three *óglaechs* that, as above, took service with Finn at *ráithín na n-ingnadh* and had the wonderful hound; it was they that slew the two warriors whose graves those are: Donn and Dubhan, the King of Ulidia's two sons out of the North.' 'How perished they?' asked the king. 'The three lay in a place apart from the Fianna,' Caeilte replied, 'with their hound centrally between them; and when once night came, there used a wall of fire to surround them so that none might dare even to look at them. On the night in question, the King of Ulidia's sons kept watch for Ireland's and Scotland's Fianna, and thrice made the circuit of the camp. The third time, however, they saw the fiery wall, and Donn said: ''Tis a strange thing how these three *óglaechs* are for now a year past, and their hound amongst them; for they have proclaimed that after nightfall none must go look at them!' Then the King of Ulidia's sons passed inside through the fire-wall; when they were there they got their arms ready to their hands, and so scanned both men and dog. But the huge hound which daily they had in the chase was at this instant no greater than a lap-dog such as a great lady or man of high estate may keep; one man moreover with his keen sword naked in his hand standing sentry over the animal, while to the mouth of the same another held a *cuach* of fair silver; and the choicest of every kind of liquor which any individual of the three might require of him, that is what the hound kept on ejecting from his mouth into the *cuach*.

"Then to the hound, an *óglaech* of them said: 'It is well, thou noble and righteous and high-couraged! give heed now to the treachery wrought thee by Finn!' At this the hound wagged his tail hard, whereby was created a factitious magic wind that made their shields to fall from our men's hands, their swords from their sides, and to be cast before their faces into the fiery wall. Hereat the three killed the King of Ulidia's two sons; which being effected, the dog

turned, applied his breath to them, and reduced them to dust and ashes, so that nor blood, nor flesh, nor bone was ever found of them. 'Theirs, then, are the two mounds concerning which thou questionest me,' ended Caeilte: 'but, mould and sand excepted, whosoever should open them would not find them to contain the smallest thing.'"

This remarkable passage, in addition to the evidence it furnishes of the erection of cenotaphs in prehistoric times, is of interest as showing that the tradition that some mounds were "blind mounds" was handed down to a late period. At what time the practice of erecting cenotaphs ceased in Ireland we cannot say, or whether or not the people of the early Christian period had contemporary knowledge of such monuments; but the fact that the existence of cenotaphs has been preserved in tradition seems to explain a circumstance in connexion with them noted by several observers.

Mounds, which subsequently proved to be "blind," in several instances showed no signs of previous disturbance.

Dr. Naue speaks of blind mounds explored by him as "la plupart très bien construits" (note, p. 18). Canon Greenwell describes Willie Howe as "well proportioned and symmetrically made." No sign of disturbance was noticed at the apparent entrance to Cairn "D" at Loughcrew, the interment in which it was therefore thought would be found intact. Can the explanation of a case such as Cairn "D," where we find the other cairns of the cemetery have been systematically rifled, be that the fact that it did not contain anything was well known in the locality, and it was, therefore, passed over by the mound plunderers of early times; or did the knowledge of the treasure-seekers of the practice of erecting cenotaphs enable them to detect such empty mounds without the necessity of an exhaustive search?

III.

REPORT UPON THE RAISED BEACHES OF THE NORTH-EAST OF IRELAND, WITH SPECIAL REFERENCE TO THEIR FAUNA. BY R. LLOYD PRAEGER, B.E., M.R.I.A. (PLATE I.)

[Read JANUARY 27, 1896.]

THE present Paper is, to a certain extent, supplementary to the Report on the Estuarine Clays of the North-East of Ireland, submitted to the Academy in 1892.[1] It is a matter of regret to me that the termination of my residence in the North of Ireland prevented a more full and detailed survey of the raised beaches of the north-east; but it may be doubted if this would have added much of novelty to our knowledge of the characters and fauna of these deposits, as the more important localities, such as Larne and Portrush, have now been well worked up.

The raised beaches of the north-east have come in for a good deal of attention from geologists, and the literature of the subject is comparatively extensive. Only a few papers, however, contain more than short and general descriptions, and but very few contain definite information relative to the fauna of the beds. It is to these last alone that I shall have occasion to refer. But let it be said, that from the writings in general we gather that at frequent intervals round the north-eastern coast there exist accumulations of gravel and sand, varying in level from high-water mark to about twenty feet above it, and containing throughout marine shells of species, in most cases still living in the vicinity, and, frequently mixed with these, worked flints of distinctly human origin, so that these beds were accumulated, and their elevation effected, during the human period. The raised beaches frequently rest on blue marine clay, characterized by *Scrobicularia piperata*, *Tapes decussatus*, and other littoral shells. Overlying the same clay, in the more open bays and estuaries, we frequently find a deposit of blue marine clay, filled with shells that frequent water of five to ten fathoms in depth. I have elsewhere[2]

[1] Proc. R. I. Academy, 3rd ser., vol. ii. [2] *Loc. cit.*

expressed my belief that the series of raised beaches referred to is contemporaneous with this upper clay bed, and that the elevation that raised the gravels to their present height, brought up the clays from their place of deposit in some few fathoms of water to their present position at or near high-water mark.

Professor Hull has pointed out[1] that the elevation above present sea-level of the raised beaches of the east coast of Ireland increases as we pass northward, varying from high-water mark at Dublin to twenty feet above it on the Antrim coast; and he identifies this Irish series with the twenty-five-foot raised beach of Scotland. Into this suggestion (which Mr. A. Bell states[2] is not borne out by the fauna) I need not at present inquire, but may remark that my observations bear out, on the whole, Hull's statement as to a general increase of elevation with increasing latitude.

Without further preface I shall proceed to my notes on raised beaches, and they will be taken in geographical order, beginning with the most southern.

GREENORE.

The raised beach at Greenore forms an extensive spit of low land, projecting for half a mile into Carlingford Lough, and it has been long known as a locality for rude flint implements. It is composed of horizontally-bedded gravels, rising to about fifteen feet above high-water mark, and containing marine shells from bottom to top. The gravels rest on estuarine clay, with gravelly layers. The fauna of the gravels, as observed on a single visit, is as follows:—

Anomia ephippium.
Ostrea edulis.
Pecten maximus.
Lucina borealis.
Cardium edule.
Tapes decussatus.
T. aureus.
Tellina balthica.
Scrobicularia piperata.
Mya arenaria.
Trochus cinerareus.
Littorina obtusata.
L. litorea.
Turritella terebra.
Purpura lapillus.

The estuarine clay which underlies the gravels and its fauna have been treated of in my report before-mentioned.

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[1] "On the Raised Beach of the North-East of Ireland," Brit. Assoc. Report, 1872, and Physical Geol. and Geogr. of Ireland, p. 107.

[2] "Final Report . . . upon the Manure Gravels of Wexford," Brit. Assoc. Report, 1890.

Carlingford.

Just a mile from Carlingford Castle, on the way to Greenore, beyond a piece of brackish water lying inside the railway, the road makes a slight cutting through a raised beach for a length of about one hundred yards. The only section is on the banks by the roadside. There is to be seen a solid bed of oyster-shells, at between fifteen and twenty feet above high-water mark, and for a few feet above and below this layer are shell-bearing gravels. The deposit rests on Carboniferous limestone. The shells found were—

Ostrea edulis. v. c.	*Patella vulgata.* r.
Cardium edule. r.	*Littorina obtusata.* r.
Tapes decussatus. v. r.	*L. litorea.* c.

Greencastle.

On the side of Carlingford Lough opposite to that last-mentioned, at the uttermost southern extremity of county Down, an extensive sea-terrace is marked on the Geological Survey map. The only place here which I have had an opportunity of examining is the shore from Cranfield Point north-westwards. At Cranfield Point the great deposit of granite detritus, which stretches round the southern slopes of the Mourne Mountains, forming in many places a thirty or forty-foot cliff facing the sea, gives way to compact blue boulder-clay, with large blocks of polished Carboniferous limestone. A little northward the boulder-clay is capped by a few feet of marine gravels, eight or ten feet above high-water mark, evidently a raised beach. *Saxicava rugosa*, *Patella vulgata*, and *Littorina litorea* were collected, the first in a limestone pebble. Further northward the Carboniferous limestone crops out in low reefs on the shore.

Killough.

At the head of Killough Bay a low estuarine flat runs inland for about a mile, at a level slightly above high water. Drain-cuttings here show a foot of sandy clay, then a shelly layer, and under that several feet (base not seen) of very fine, tough, pink and grey laminated clay, without shells. The shell layer is made up of abundance of *Cardium edule*, *Tellina balthica*, *Scrobicularia piperata*, and *Littorina litorea*. Stretching across the lower end of this flat, a fine raised beach faces the sea. The Ardglass railway runs along the top of the raised beach, and cuts through it at Killough Station. At this

spot, it is seen resting on red boulder-clay, its surface being twelve to fourteen feet above high water. Shells of a few species are abundant—

Cardium edule. c.	*Trochus umbilicatus.* f.
Trochus cinerareus. c.	*Ostrea edulis.* v. r.
Littorina obtusata. c.	*Purpura lapillus.* v. r.
L. litorea. c.	*Nassa (incrassata?)* v. r.

SANDEEL BAY.

Round this little bay, which lies east of Groomsport, extends a cliff of fine sand, rising from near high-water mark to a height of fifteen feet. A level field extends backwards from its top. The sand is stratified horizontally, and is full of marine shells, which occur in beds and irregular pockets, some of which almost suggest human agency. *Patella vulgata, Littorina obtusata, L. litorea,* and the land-shell *Helix acutus* are the prevailing species. I also observed *Pecten pusio, Mytilus modiolus, Venus gallina, Tapes virginius, Solen* sp., *Trochus cinerareus, Littorina rudis.*

BALLYHOLME BAY.

Before the present sea-wall was built, the raised beach here overhung the strand as a cliff of sand and gravel twenty feet in height, inhabited by quantities of sand-martins. Shells are rare in this bed; but at one spot, in a sandy layer three feet below the surface, and fifteen feet above high water, I obtained *Ostrea edulis, Mactra subtruncata, Trochus cinerareus, Littorina obtusata.* The shells were in a very crumbling condition. The gravels, which lie in horizontal beds, rest, at about half-tide level, on a thin layer of blue clayey sand, representing probably the Estuarine clay zone. Below this is the well-known bed of submerged peat, only about six inches thick, but containing the upright stumps of Scotch fir and other trees, in their natural position. Below this is a thin layer of bluish sandy clay, very tough, and full of branches and roots, succeeded by fine red sand or fine red clay. To the westward the boulder-clay rises up from below this series.

CARNALEA.

Mr. W. H. Patterson pointed out to me a rather interesting deposit on the shore below Carnalea Station. It consists of a shell bed of small extent, six to twelve inches thick, lying irregularly on

the Ordovician rocks of the shore, about six feet above ordinary high-water mark. It is covered with one foot of reddish clay, evidently washed down from the slopes above. The shells are tightly wedged together, and, though all still living in the neighbourhood, they are of interest as having a much less littoral character than is usual in the beds we are considering—

Anomia ephippium. f.
Ostrea edulis. c.
Pecten varius. r.
P. opercularis. f.
P. pusio. f.
P. maximus. f.
Venus exoleta. v. c.
V. lincta. r.
V. fasciata. f.
Cardium echinatum. c.
Cyprina islandica. r.
Lutraria elliptica. f.
Solen ensis. r.
Patella vulgata. c.
Trochus cinerareus. c.
T. umbilicatus. f.
T. magus. v. r.
Littorina obtusata. c.
L. litorea. c.
Rissoa membranacea. v. r.
Hydrobia ulvæ. v. r.
Turritella terebra. c.
Cerithium reticulatum. r.
Aporrhais pes-pelecani. f.
Nassa reticulata. r.
Fusus antiquus. f.
F. gracilis. v. r.
Pleurotoma rufa. v. r.
Cypræa europeæa. v. r.
Serpula vermicularis. f.
Balanus sp. f.

KINNEGAR, HOLYWOOD.

The Kinnegar is a sickle-shaped bank of gravel, running for half-a-mile from the slight promontory on the shore below the town of Holywood, in a direction parallel to the coast. The gravels rest on the thick deposit of estuarine clay that fills the upper portion of Belfast Lough, and they have been long noted as yielding flint implements. At the extreme point the bank bends sharply backwards, so as to form a little hook. In the construction of a rifle range in 1887 this hook was cut through, and was found to consist of sand and shells, lying on the estuarine clay, and running in under the gravels, which rested on it in tolerably even horizontal beds (Pl. I., fig. 1). The following shells were noted :—

Anomia ephippium. f.
Ostrea edulis. v. c.
Mytilus edulis. v. c.
Cardium edule. v. c.
Venus exoleta. v. r.
V. gallina. v. r.
Tapes virgineus. f.
T. pullastra. r.
T. decussatus. f.
T. aureus. r.

Tellina balthica. f.	*Turritella terebra.* c.
Mactra subtruncata. v. c.	*Cerithium reticulatum.* c.
Solen ensis. r.	*Nassa reticulata.* r.
Patella vulgata. f.	*Buccinum undatum.* c.
Trochus cinerareus. r.	*Fusus antiquus.* f.
Littorina obtusata. c.	*Murex erinaceus.* v. r.
L. litorea. v. c.	*Purpura lapillus.* f.

The deposit is, however, practically composed of *Ostrea*, *Mytilus*, *Cardium*, *Mactra*, and *Littorina litorea*, mixed with sand. Immediately above this bed was a layer of grey sand a foot deep, succeeded by the gravels which form the Kinnegar. The sand was destitute of shells, nor have I found shells in the overlying gravels,[1] though they have unquestionably been thrown up by the sea as a bank between tides, or at low-water mark. And this leads me to repeat that the term 'raised beach' is commonly used to describe not only *beaches*, but also *banks* and *sea-beds*, that have been elevated. The Kinnegar was undoubtedly a bank thrown up by currents, rather than a beach; the Curran at Larne, to be referred to presently, is a very fine example of an inter-tidal or submarine bank which has been elevated. A bank of similar character, still at its original level, and, like the Kinnegar and Curran, forming a sickle-shaped spit, may be seen at low tide at Killowen, near Rostrevor.

WEST BANK.

Though it cannot be described as a raised beach, being situated between high and low-water level, reference may be made to a curious deposit of shells occurring at the point of the West Bank, which projects eastwards across Belfast Lough, three miles below Queen's Bridge, and which, till cut through in the formation of the Victoria Channel, formed a barrier round which all vessels approaching Belfast had to steer. The point of the bank, which is composed of over thirty feet of solid estuarine clay, gleams white at low water on a sunny day but it was not until I visited the spot, in 1891, that I learned the cause of its brilliance. At low spring tide, amid miles of dreary mud-flats, the point of the bank rises out as a steep slope of pure shells,

[1] Canon Grainger has recorded, in "Nat. Hist. Review," 1859, Proc., p. 15, the following shells from "ten-feet elevation, Kinnegar, Holywood":—*Anomia aculeata*, *Ostrea edulis*, *Cardium edule*, *Mactra subtruncata*, *Littorina litorea*, *Turritella communis*, *Cerithium reticulatum*, *Nassa reticulata*.

six feet in height. *Mytilus edulis*, which lives in thousands on the surrounding flats, constitutes about ninety per cent. of the whole, but the remainder include a number of species which do not now live in the immediate vicinity—

Ostrea edulis. f.	*Trochus cinerareus.* r.
Anomia ephippium. v. r.	*Lacuna divaricata.* v. r.
Pecten varius. v. r.	*Littorina litorea.* v. r.
P. opercularis. v. r.	*L. rudis* (juv.). r.
Nucula nucleus. v. r.	*L. obtusata.* f.
Venus gallina. v. r.	*Rissoa membranacea.* f.
Tapes aureus. f.	*R. parva.* r.
Cardium edule (juv.). r.	*R. albella.* v. r.
C. echinatum. v. r.	*Hydrobia ulvæ.* r.
C. exiguum. v. r.	*Turritella terebra.* r.
Lucina borealis. v. r.	*Odostomia unidentata.* f.
Tellina balthica. v. r.	*Cerithium reticulatum.* c.
Mactra subtruncata. v. r.	*Natica catena.* v. r.
Mya arenaria. v. r.	*Nassa incrassata.* f.
Corbula gibba. v. r.	*Pleurotoma rufa.* f.

The rarity of *Cardium edule*, *Tellina balthica*, *Hydrobia ulvæ*, and *Mya arenaria*, which live in great abundance in the vicinity, as quite as noteworthy as the occurrence of many shells which are not now inhabitants of the neighbourhood. This accumulation may be paralleled with the wonderful shell-banks of Lough Foyle, which have been referred to by Portlock,[1] from which, at the time he wrote, over 59,000 tons of shells, chiefly *T. terebra*, were removed annually, without any failure or diminution in the supply. In that case, as in the present, most of the shells cannot have lived in the vicinity, but must have been brought by tidal currents.

Kilroot.

The raised beach at Kilroot was mentioned, and a short list of its shells given, by Hull, in 1872,[2] the species recorded being *Anomia ephippium*, *Cardium edule*, *Patella vulgata*, *Trochus umbilicatus*, *Littorina litoralis*, *L. litorea*, *Cerithium reticulatum*, *Nassa reticulata*, *Buccinum undatum*. In the Memoir to Sheets 21, 28, and 29 of the

[1] "Geology of Londonderry," &c., 1843, p. 163.
[2] Report of Brit. Assoc., 1872.

Geological Survey of Ireland (1876) this list is repeated, with the addition of *Pecten maximus*.

Mr. Mark Stirrup, F.G.S., in his Paper on "The Raised Beaches of County Antrim," [1] gives a list of "shells of old beach, mixed with recent ones," found on the shore at Kilroot: the species which are not marked as "recent" are—*Mytilus edulis, Patella vulgata, Trochus cinerareus, Littorina littoralis, L. litorea, Rissoa* sp., *Purpura lapillus, Buccinum undatum, Nassa reticulata.*

The raised beach is seen along the shore west of Kilroot railway station. On the foreshore, at Kilroot Point, there is a small exposure of estuarine clay of the lower or Scrobicularia zone,[2] resting on a thin bed of submerged peat, which lies on red boulder-clay. Before the present sea-wall was built, the gravels were seen to rest on the estuarine clay, so that here we have the typical succession—

Raised beach.
Estuarine clay.
Submerged peat.
Boulder-clay.

The raised beach was formerly well exposed in gravel-pits by the railway, a short distance west of Kilroot Station, and yielded many rude flint implements, as has been recorded by Du Noyer[3] and others; but these pits are lately worked out. On the shore the raised beach may be seen as a thin band of shell-bearing gravel three to four feet above high-water mark, resting on boulder-clay, or on New Red marls. At one point the section is as shown in Plate I., fig. 2. I have the following shells noted from the Kilroot raised beach:—

Anomia ephippium.
Ostrea edulis.
Mytilus edulis.
Cardium edule.
Venus exoleta.
Tapes decussatus.
T. aureus.
Tellina balthica.
Mactra subtruncata.
Mya truncata.
Patella vulgata. c.
Trochus cinerareus.
Littorina obtusata. v. c.
L. litorea. v. c.
Cerithium reticulatum.
Nassa reticulata.
Purpura lapillus.
Buccinum undatum.
Cypraea europaea.

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[1] Proc. Lit. and Phil. Soc. Manchester, xvi. (1877).
[2] See "Report on the Estuarine Clays," &c., p. 214.
[3] Journ. Geol. Soc. London, vols. xxiv, xxv.

Larne.

The beds at the Curran at Larne form the classic raised beach of the north of Ireland. Many papers contain references to this deposit, especially in its archæological aspect, as a famous locality for rude flint implements. I need only mention such as refer to its geological and palæontological features. Hull[1] records, as found in this raised beach, eleven species of mollusca. Grainger[2] gives a list of twenty-five species obtained by him at heights varying from ten to twenty feet above high water. In Mr. Stirrup's paper, already referred to, a list of nineteen species is given. In the Report of the Belfast Nat. Field Club [first] Larne Gravels Committee[3] a few species are mentioned, which were determined by Mr. S. A. Stewart. In the Report of the Field Club's second Committee of Investigation,[4] which was drawn up by myself, fifteen species are noted. I give a full list of the fossils which have been found, distinguishing the authorities by the initial letters of their names (H. = Hull, G. = Grainger, Sp. = Stirrup, St. = Stewart, P. = Praeger):—

Anomia ephippium. H. G. Sp. St.
Ostrea edulis. G. P.
Pecten varius. G.
P. maximus. S. P.
Kellia suborbicularis. G.
Lucina borealis. G. Sp. St. P.
Cardium edule. H. G. Sp. St. P.
C. exiguum. Sp.
Cyprina islandica. P.
Venus lincta. S.
Tapes pullastra. G. Sp. P.
T. decussatus. P.
Tellina balthica. S.
T. tenuis. G.
Mactra species. Sp.
Scrobicularia alba. Sp.
Corbula gibba. G.
Saxicava rugosa. G.
Patella vulgata. H. G. Sp.
Helcion pellucidum. G.
H. pellucidum, var. *lævis.* Sp.
Trochus cinerareus. G. Sp. P.
T. umbilicatus. H. Sp.
T. magus. G.
T. zizyphinus. G. P.
Littorina obtusata. H. G. Sp. St. P.
L. litorea. H. G. Sp. St. P.
L. rudis. G. Sp. St. P.
Rissoa membranacea. H.
Turritella terebra. G. P.

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[1] Brit. Assoc. Report, 1872.
[2] Brit. Assoc. Report, 1874.
[3] Proc. B. N. F. C., 1886–87, p. 519.
[4] *Ibid.*, 1889–90, p. 198.

Cerithium reticulatum. H. G.
Natica species. Sp.
Nassa reticulata. H. G. Sp.
N. pygmæa. G.
Purpura lapillus. G. Sp. P.
Buccinum undatum. H. G. Sp. P.
Fusus antiquus. H.

The molluscan fauna of the gravels is yet by no means thoroughly worked out. Mr. Joseph Wright has recorded[1] sixty species of Foraminifera from these gravels.

Such full descriptions of the Curran beds have been published in the Papers already referred to, that it is only necessary to summarize that at their place of greatest development they consist of current-bedded gravels, twenty-one feet in thickness, containing marine shells and worked flints from top to base, and resting on estuarine clay, the surface of which is at high water level. The vertical position of certain bivalves proves that they lived buried in the gravels while the deposit was accumulating. This, and the bedding, show that the deposit is an old inter-tidal, or submarine, bank. Sections on different parts of the Curran vary greatly. On the south side of the railway, close to the Curran station, was seen the succession just mentioned. A hundred yards northward a bank of boulder-clay rises up, till there is only two feet of gravel on the top of it. In pits at the old pottery, six feet of gravels overlay the estuarine clay, the surface of which was here six feet above high water. In a ten-foot-deep trench, made in 1887 for the Larne outfall sewer, along the road which crosses the Curran near this old pottery, a good section was exposed, as in Plate I., fig. 3, which shows the beds actually seen in the cutting from the old pottery to the eastern shore. The thick bed of yellow sand, which at this place suddenly intervenes between the gravels and the estuarine clay, contained many shells. In the ten minutes at my disposal on the day when I saw the cutting, the following were noted:—

Anomia ephippium. v. r.
Ostrea edulis. c.
Pecten varius. v. r.
P. maximus. f.
Montacuta bidentata. f.
Lucina borealis. v. r.
Pectunculus glycymeris. c.
Cardium edule. c.
Venus exoleta, c.
V. fasciata, r.

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[1] "Post-Tertiary Foraminifera of N.-E. Ireland," Proc. B. N. F. C., 1879–80, Appendix.

V. ovata. v. r.
Tapes virgineus. v. r.
T. aureus, var. *ovata.* v. r.
Tellina balthica. c.
Scrobicularia alba. v. r.
S. piperata. r.
Patella vulgata. c.
Helcion pellucidum. var. *lævis.* v. c.
Trochus cinerareus. c.
T. umbilicatus. v. r.
T. magus. v. r.
Lacuna divaricata. v. r.
Littorina obtusata. v. r.
L. litorea. c.
L. rudis, var. *tenebrosa.* v. r.
Rissoa striata. r.
Hydrobia ulvæ. r.
Aclis supranitida. v. r.
Cerithium reticulatum. v. r.
Purpura lapillus. c.
Buccinum undatum. r.
Murex erinaceus. v. r.
Melampus bidentatus. v. r.

This is by far the most fossiliferous bed yet discovered in the Larne raised beach, and ten of the species are additions to the fauna; the shells were in a much better state of preservation than those of the overlying gravels.

Stirrup[1] mentions this sand bed as fringing the present shore from Larne [Harbour] northward to Waterloo, capped by gravels, the top of which was five to six feet above high water. The sand contained thick beds of shells, consisting for the most part of Patellæ, Littorinæ, and Trochi, which might be traced for several yards at a time, and then died away. He notes the following species of fossils:—*Patella vulgata*, *P. lævis*, *Pectunculus glycymeris*, *Scrobicularia piperata* (?), *Trochus cinerareus*, *Littorina littoralis*, *L. rudis*, *L. litorea*, *Purpura lapillus*, tooth of *Bos longifrons*. The last-named was found firmly embedded in the sand at its junction with the overlying gravel, and was determined by Prof. Boyd Dawkins. On account of its smaller elevation above the sea, he placed this deposit on a horizon with the raised beach at Kilroot, &c., and considered them of a later date than that of the Curran (along with which, by the way, he places the glacial raised beach of Ballyrudder, which is capped by a thick deposit of boulder-clay). But in spite of the much better preservation of its fauna, there can be no doubt that the sand-bed is of the same age as the Curran gravels, and has its place, indeed, near the base of the series. Fig. 3 shows clearly how the sand runs in under the gravels, and as to the state of preservation of its fauna, it has elsewhere[2] been stated that the fossils in the lowest bed reached during the

[1] *Loc. cit.*
[2] Proc. B. N. F. C., 1889–90.

excavations of the Belfast Field Club Committee, were remarkably fresh and well-preserved, much more so than those of the superior beds.

This completes my own notes on the north-eastern raised beaches, but it may be allowed to me to briefly mention any records of fossils that have not been already referred to, in order that a complete view may be obtained of the raised beach fauna, so far as it is known.

In Grainger's Paper in "Nat. Hist. Review," 1859, already referred to, the following marine shells are recorded:—

WHITE ABBEY, thirty feet elevation.—*Ostrea edulis*, *Pecten maximus*, *Mytilus edulis*, *Cardium edule*, *Tapes aureus*, *Tellina balthica*, *Trochus cinerareus*, *Littorina litorea*, *L. rudis*, *L. obtusata*, *Purpura lapillus*.

GREENCASTLE, twenty feet elevation.—*Cardium edule*, *Tellina balthica*, *Littorina obtusata*, *L. litorea*, *L. rudis*, *Hydrobia ulvæ*, *Cerithium reticulatum*.

BANKS OF THREE-MILE WATER, ten feet elevation.—*Mytilus edulis*, *Patella vulgata*, *Balanus* sp.

JORDANSTOWN, three feet elevation.—*Anomia ephippium*, *Pecten opercularis*, *Mytilus modiolus*, *M. edulis*, *Cardium edule*, *Venus exoleta*, *V. gallina*, *Tapes decussatus*, *Mactra subtruncata*, *Tellina balthica*, *Mya truncata*, *Patella vulgata*, *Littorina obtusata*, *L. litorea*, *L. rudis*, *Turritella terebra*, *Aporrhais pes-pelecani*, *Cerithium reticulatum*, *Purpura lapillus*, *Nassa reticulata*, *N. incrassata*, *Buccinum undatum*, *Fusus antiquus*, *Pleurotorna rufa*, *Serpula vermicularis*, *S. triquetra*.

CARRICKFERGUS, forty feet elevation.—*Anomia ephippium*, *Ostrea edulis*, *Pecten opercularis*, *Mytilus modiolus*, *M. edulis*, *Cardium edule*, *Mactra subtruncata*, *Trochus cinerareus*, *Littorina litorea*, *L. rudis*, *Cerithium reticulatum*, *Buccinum undatum*, *Serpula triquetra*. In "Brit. Assoc. Report," 1874, Grainger supplies the additional information, that these were collected in a raised beach beyond Carrickfergus.

The lists from "one foot elevation" are not worth giving, in the absence of any particulars regarding the conditions under which they were found. In no case in this Paper, unfortunately, is any information given relative to the deposits from which the shells were obtained; those from "sixty to eighty feet elevation, Co. Down Railway cuttings," were certainly obtained from glacial beds.[1] The remainder which I I have quoted above were, no doubt, obtained from raised beaches; but,

[1] See M'Adam, in Journ. Geol. Soc. Dublin, vol. iv., part 2, No. 2 (1850).

I believe, the height of forty feet at Carrickfergus, thirty feet at White Abbey, and twenty feet at Greencastle (which the author indicates are heights above high water) are exaggerated; so far as I am aware, the most elevated raised beach in the district is that of Larne, which rises to about twenty-two feet above high water.

Mr. W. A. Traill has noted[1] a few fossils of Antrim raised beaches:—

Craigvullen, three miles S.-E. of Glenarm, at the mouth of the stream, four to eight feet above high water.—*Venus* "*lincta* or *obsoleta*," *Patella vulgata*, *Helcion pellucidum* var. *lævis*, *Littorina obtusata*, *L. litorea*, *Trochus* sp.

Closeburn Bay, five miles S.-E. of Glenarm, in the townland of Fourscore, four to eight feet above high-water mark.—*Pectunculus glycymeris*, *Cyprina islandica*, *Patella vulgata*, *Helcion pellucidum* var. *lævis*, *Littorina obtusata*, *L. litorea*, *Trochus cinerareus*.

Lastly, we have the famous raised beach of Portrush, discovered by James Smith of Jordan-hill, and first described by Portlock[2]: "The remarkable accumulation of shells, mixed with sand, which occupies a bowl-shaped hollow, about ten feet above the sea on the north side of Portrush, and open in that direction to the sea." Portlock gives a list of the fossils, eighty-eight in number, supplied by Smith, and adds to these the coral *Caryophyllia Smithii*. Smith's own comment is worth quoting:—"This shelly deposit seems to have been a sheltered bay into which the shells have been drifted, with a small admixture of land-shells, washed down by floods; none of the bivalves have both valves together, but they have been but little injured by the action of the sea; I have never met with such a variety in so small a space, either in recent or ancient beds."

Grainger[3] gives a list of fifty-four species obtained by him in this bed, adding a few species to its fauna; Stirrup includes in his Paper a short list of its fossils; and Alfred Bell,[4] from material supplied by local correspondents, has added others, bringing up the total fauna to no less than 126 species and varieties. It is not necessary here to reproduce this long list, but attention is drawn to the occurrence of the following species:—*Lima hians*, *Venus verrucosa*, *Venerupis irus*, *Rissoa albella*, *R. costulata*, *Odostomia excavata*, *Adeorbis subcarinatus*,

[1] Geol. Surv. Ireland, Memoir to Sheet 20, p. 21.

[2] Geology of Co. Londonderry, &c., p. 161.

[3] Brit. Assoc. Report, 1874.

[4] *Ibid.*, 1890; and also Proc. Roy. Phys. Soc. Ediuburgh, vol. x. (1889–90).

Trophon muricatus. The Foraminifera of the deposit, to the number of sixty, have been determined and catalogued by Wright.[1] It is a matter for congratulation that this important deposit has been so thoroughly worked up, as some years ago it was destroyed in the process of road-making.

I have now enumerated, or referred to, all records that I know concerning the raised beach fossils of the north-east of Ireland; and it will be interesting to compare this fauna with that of the deposits which immediately underlie the raised beaches, with that of contemporaneous beds of different character, and with the present fauna of the same regions. I would refer to my Report on the Estuarine Clays, pp. 213–6, for a sketch of the geological succession and general character of the post-glacial series in the north-east of Ireland, and the changes of conditions which they prove. It may be briefly stated that the typical series is in descending order:—

$$\left.\begin{array}{l}\text{Raised beaches,}\\ \text{Upper estuarine clay,}\end{array}\right\}\text{Cotemporaneous.}$$

Lower estuarine clay.
Submerged peat.
Sands and gravels.
Boulder-clay.

The only fossiliferous Pleistocene bed yet discovered below the boulder-clay of the district, is the gravel-bed of Ballyrudder, which yields a markedly Arctic fauna.

The boulder-clay of the north-east exhibits the well-known typical characteristics. Overlying it, in many places, is a fine hard red clay, almost devoid of pebbles or blocks. This bed is more fossiliferous than the stony clay which it overlies. Above this, sands and gravels attain locally a considerable development, especially in the neighbourhood of Belfast. These beds require further elucidation: so far as they have been examined they yield sparingly a fauna similar to that of the boulder clay. The peat-bed, which comes next in the succession, offers a tempting field for research. Well-preserved plant remains, and elytra of beetles, &c., are often abundant, and mammalian remains occur.[2] We do not yet know much of the fauna and flora of this bed, but it contains remains of hazel, alder, oak, willows, Scotch fir, sedges, and flags. Resting on the peat bed comes the

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[1] *Loc. cit.*

[2] See "Report on Estuarine Clays," &c.

lower or Scrobicularia zone of the estuarine clay, a littoral deposit which underlies a deposit of deeper water, the upper estuarine clay, and, in other places, the raised beach or sea-bed.

We are now in a position to compare the faunas of the successive deposits of the series. This will yield the best and most instructive results if, eliminating all those species which range both north and south of the British area, we select the species which are of distinctly northern or southern type—those which either have now their habitat altogether outside British waters, or have the boundary (northern or southern) of their area of distribution within this region. This should, if the material at our disposal be sufficient for such an analysis, give us a key to the northward or southward fluctuations of the fauna during the periods of deposition of the beds under consideration. I may add that nowhere else in Ireland could such a comparison be instituted, nor do I know of any area of the same size in England or Scotland where the glacial, post-glacial, and recent molluscan faunas are all so completely represented and so available for comparison. The Ballyrudder gravels and Belfast Waterworks boulder-clay are the most fossiliferous glacial deposits in Ireland. The estuarine clays, with a total fauna of 340 species, present, so far as I am aware, the richest post-glacial fauna in the British Isles; and the raised beaches, with a fauna of about 130 species, also abundantly represent the life of the period. Lastly, the extensive researches of Thompson,[1] Hyndman,[2] and Dickie[3] furnish us with full information regarding the existing molluscan fauna of the north-east.

For the purposes of this comparison it is necessary to assume that the shells found in the various beds lived in the neighbouring seas at the time of the deposition of the beds. There is, of course always the chance of derived fossils, but this chance is small, to judge from the very small percentage of derived forms in recent dredgings or on our existing beaches. As regards the present fauna, however, this risk has been obviated by admitting only such species as have been taken alive in the district.

The Ballyrudder gravels yield a percentage of exotic forms so much higher than that of the local glacial clays, that it has been thought advisable to give this deposit a separate column. The term

[1] "Natural History of Ireland," iv., 1856.

[2] "Reports of the Belfast Dredging Committee," Brit. Assoc. Reports, 1857, 1858, 1859.

[3] "Report on the Marine Zoology of Strangford Lough," Brit. Assoc. Report, 1857.

glacial clays has been used in preference to boulder-clays, since the fine clay, often without boulders, which has been already referred to, has yielded more fossils than the boulder-clay proper. The placing of the raised beaches after the estuarine clays, is not intended to signify necessarily a stratigraphical relation; but it may be assumed, with tolerable certainty, that the raised beaches are in no case *older* than the clays.

N represents a species of Arctic distribution, not now living in the British area. N represents a species, whose present distribution ranges from Britain northward only: most of these have their headquarters on the Scandinavian shores. S represents a species whose present distribution ranges from Britain southward only: most of these have their headquarters in the Mediterranean.

SPECIES.	Ballyrudder.	Glacial Clays.	Estuarine Clays.	Raised Beaches.	Existing Fauna.
Rhynchonella psittacea,	**N**	—	—	—	—
Mytilus modiolus,	—	—	N	N	N
Pinna rudis,	—	—	—	—	S
Crenella decussata,	—	—	N	—	N
Leda pernula,	**N**	**N**	—	—	—
Arca lactea,	—	S	—	S	—
Astarte elliptica,	N	N	—	—	—
A. compressa and var. globosa,	N	N	—	—	—
A. borealis,	**N**	**N**	—	—	—
Venus verrucosa,	—	—	—	S	—
Venerupis irus,	—	—	—	S	—
Tapes decussatus,	—	S	S	S	—
Tellina calcarea,	**N**	**N**	—	—	—
T. donacina,	—	—	—	—	S
Gastrana fragilis,	—	—	S	—	—
Lutraria obtonga,	—	—	S	—	—
Thracia pubescens,	—	—	S	—	—
Gastrochæna dubia,	—	—	S	—	—
Pholas parva,	S	—	—	—	—

Species.	Ballyrudder.	Glacial Clays.	Estuarine Clays.	Raised Beaches.	Existing Fauna.
Chiton marmoreus,	N	—	—	N	N
C. albus,	—	—	—	—	N
Puncturella noachina,	N	—	—	N	—
Tectura testudinalis,	—	—	—	—	N
Emarginula crassa,	—	—	—	—	N
Trochus helicinus,	—	—	N	—	N
T. umbilicatus,	—	—	S	S	S
T. lineatus,	—	—	—	—	
T. granulatus,	—	—	—	—	S
T. montacuti,	—	—	—	—	S
Phasianella pulla,	—	—	S	S	S
Rissoa costulata,	—	—	S	S	—
Jeffreysia opalina,	—	—	S	—	—
Turritella erosa,	N	—	—	—	—
Odostomia pusilla,	—	—	S	—	—
O. excavata,	—	—	—	S	—
Natica affinis,	N	N	—	—	—
Adeorbis subcarinatus,	—	—	—	S	—
Trichotropis borealis,	—	—	—	—	N
Buccinum grenlandicum,	N	—	—	—	—
Fusus latericeus,	—	N	—	—	—
Trophon truncatus,	N	N	—	—	N
T. clathratus,	N	N	—	—	—
T. barvicensis,	—	—	—	—	N
T. muricatus,	—	—	—	S	—
Defrancia gracilis,	—	—	S	—	—
Pleurotoma exarata,	N	—	—	—	—
P. decussatus,	—	N	—	—	—
P. trevelyana,	N	—	—	—	—
P. pyramidalis,	N	—	—	—	—

I believe that if to the above Table were added those species whose distribution is *mainly* northern or southern (instead of *entirely*, as in the Table) the changes in the character of the fauna would be rendered still more conspicuous; but the groups of shells used above will sufficiently serve the purpose.

From an inspection of the above Table the Arctic character of the Ballyrudder fauna, and the northern character of the fauna of the boulder-clays, is at once apparent. Not less striking is the distinctly southern character of the estuarine clay fauna, and of the raised beaches, when contrasted with the columns showing the facies of the existing fauna. If we add up each column, and reduce the results to percentages of the total fauna of each deposit, this result is still more striking—

—	Arctic.	Northern.	Southern.
Ballyrudder, ..	25	15	3
Glacial Clays, ..	13	5	3
Estuarine Clays, ..	0	2	6
Raised Beaches, ..	0	3	9
Present Seas, ..	0	4	3

This result may be expressed graphically, as shown below. In fig. 1 (p. 48) horizontal distance represents time. We have no data for arriving at even a rough comparison of the relative intervals between the periods under consideration, so they are assumed to be equal. On one side of a base-line the percentage of northern or southern species in each fauna is marked off. We thus get three curves, representing the increase or decrease in the northern or southern character of the fauna of the north-east of Ireland, from glacial times to the present day.

And furthermore, if, as in fig. 2 (p. 48), we let vertical distance on one side of the base-line represent percentage of northern forms, and on the other, percentage of southern forms (the one being, so to speak, of opposite sign to the other), and draw a curve, which is the mean of the

three curves in fig. 1, this curve will give an accurate representation of the changes in the character of the fauna, as a whole, during the same

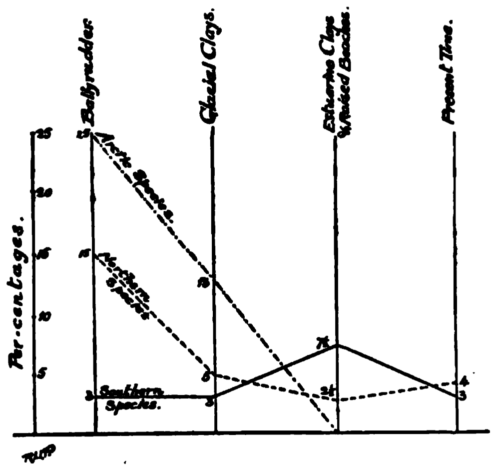

Figure 1.

period. In these two diagrams we observe the high northern character of the Ballyrudder fauna. A rapid dying out of Arctic and northern

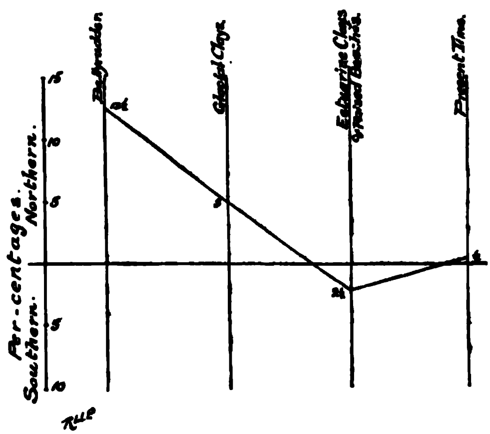

Figure 2.

species leaves the fauna of the boulder-clay still with a distinctly northern aspect. The high northern species now all disappear, and

the large increase of southern shells is accompanied by a slight further decrease of northern types, till before the next period the mean curve, indicating the general character of the fauna, has crossed the neutral line, and the fauna of the estuarine clays and raised beaches is seen to be of distinctly southern aspect. This is, however, the period of maximum dominance of the southern shells. Their number is seen to rapidly diminish, while the northern element remains almost the same, so that at the present day the neutral line has been again passed, and the fauna has assumed a slightly northern aspect.

A cause for this recent collapse of the southern fauna of the north-eastern seas has not, so far as I am aware, been suggested, nor have I any explanation to offer. It may be pointed out that the north-east of Ireland has, at present, the most northern molluscan fauna of any portion of the country, and this, as the diagram shows, is caused by the extinction of southern forms rather than by the immigration of northern ones.

The present Paper may fittingly conclude with a detailed account of a few of the more striking of these recent emigrations from the district. It is to be noted that the north-eastern part of Ireland is, both zoologically and botanically, the most boreal. The mild influences which characterize the western coast extend right up to the most northerly point of Donegal and of Ireland; and both fauna and flora, terrestrial and marine, attain their most northerly aspect only when we turn southward round Malin Head, and reach the counties of Derry and Antrim. In accordance with this statement, it will be seen that some of the shells about to be mentioned, which have now forsaken the north-eastern shores, or show a striking diminution in numbers, still flourish in the milder climate of Donegal, which is actually further to the northward; while, on the other side, their line of retreat has been down the east coast towards Dublin.

Lima hians, Gmel. In the estuarine clay period lived in immense abundance in Larne Lough, and more sparingly in Belfast Lough, and off Portrush. Now almost extinct in the district, a very few specimens only having been dredged; lives in abundance in Mulroy Bay, Co. Donegal, and sparingly off Dublin, but is not recorded from the south or west.

Tapes aureus, Gmel. Its first appearance locally is in the boulder-clay at Belfast Waterworks. It attains great abundance in the estuarine clays and raised beaches, from Larne to Greenore. As a living species it is extremely rare in the district, and in Ireland has its headquarters in the west and south.

Tapes decussatus, L. A southern shell, which first appeared, like the last, in the Waterworks boulder-clay. Attained immense profusion in the estuarine clay period, but has now become completely extinct in the district, having its limit in Lough Swilly on the one side, and Carlingford Lough on the other. Beyond these limits it is a common species round the Irish shores.

Lucinopsis undata, Penn. Attained an abundant and luxuriant development in the estuarine clay period: now almost extinct in the district, but found at Portrush and Magilligan. Lives in Lough Swilly and westward, and on the easternside at Dublin.

Gastrana fragilis, L. A southern shell, which appears in the estuarine clays of Strangford Lough. In a living state its nearest station is Lough Swilly. Elsewhere in Ireland, its present stations are in the south and west.

Scrobicularia piperata, Bell. Appears in the Waterworks boulder-clay. In the lower, or littoral, estuarine clay it is almost invariably present in immense profusion, along the whole north-eastern coast. Now quite extinct in the same area, having its nearest stations just outside these limits, in Lough Swilly and in Carlingford Lough. Common all round the rest of the Irish coasts.

Rissoa albella, Lovèn. Occurs, often in enormous numbers, in almost every bed of estuarine clay in the loughs of Foyle, Larne, Belfast, Strangford, and Carlingford, as well as in the Portrush raised beach. Now completely extinct, and in Ireland only found at Bantry Bay in the extreme south-west.

Equally instructive is the evidence afforded by certain raised beaches of the former extension northwards and eastwards of species which are characteristic of the west-coast fauna.

Venus verrucosa, L. A southern shell, recorded from the Portrush raised beach, and from prehistoric shell-mounds at Rosapenna in North Donegal.[1] It is an abundant species in the south-west, now finding its limit on the south coast at Youghal, and on the west coast in Co. Sligo.

Venerupis irus, L. Another characteristic west-coast species of southern type, not now known north of Bundoran, but occurring in the Portrush raised beach.

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[1] W. H. Patterson, in Irish Naturalist, III., p. 50 (1894).

Trochus lineatus, D. C. Abundant at the present time on the west coast, as far north as Bundoran. Rare on the east coast, but ranges north to Ballywalter in Co. Down. Its presence in the raised beach at Fort Stewart, on Lough Swilly, attests its further former extension.

Certain genera also exhibit, as a whole, striking fluctuations. Trophon, so characteristic of glacial beds, is, with the exception of *T. muricatus* in the Portrush bed, entirely absent in the estuarine clays and raised beaches, re-appearing in the present north-eastern seas with three species. Leda, another abundant glacial genus, with three species in the local deposits of this age, is represented in the estuarine clays and raised beaches by only a single valve of *L. minuta* at Belfast, though two species inhabit our present waters. Astarte, with four species in the glacial beds, is completely absent from the estuarine clays and raised beaches, re-appearing with two species at the present day. Cyprina is, very strangely, almost absent from the glacial beds of the north-east; it is likewise extremely rare in the estuarine clays and raised beaches, though now living in abundance. Tapes, a genus of rather southern proclivities, is not represented in the Ballyrudder beds, and but very sparingly in the boulder-clays. In the estuarine clays and raised beaches all the British species are widely diffused, often in very great abundance, while at the present day one species, as already mentioned, has migrated completely from the district, and another is almost extinct. Venus, another genus of southern tendency, is unknown at Ballyrudder, and very sparsely represented (two species only) in the boulder-clays. The estuarine clays yield all the six local species, which have, if anything, increased in numbers since that period. Montacuta, unknown in the glacial beds, swarms in the estuarine clay, and is now extremely rare.

We have now traced, so far as is possible, the history and character of the marine fauna of the north-eastern corner of Ireland. We see that, following the Arctic climate that must have obtained when the raised beach of Ballyrudder was laid down, somewhat warmer seas existed during the boulder-clay period, inhabited by a fauna still distinctly northern, but containing a few southern forms, along with a diminishing number of Arctic species. It may be remarked, in passing, that the character of this fauna closely corresponds to that of the boulder-clay of Kill-o'-the-Grange, near Dublin, recently described by Professor Sollas and the writer.[1]

[1] Irish Naturalist, iv., p. 321, December, 1895.

A long period, represented by the eskers, brick-clays, and submerged peat, must have intervened before the deposition of the next bed of the series.

The peat bed, so far as we know its flora and fauna, points to a climate not much differing from that which exists at present, and to an elevation of the land slightly greater than at present. A slight submergence allowed the deposition of the lower estuarine clay, with its rather southern fauna, and a further submergence was followed by the accumulation of deposits of mud in the shape of the upper estuarine clay, of sand-banks, such as the Curran of Larne, and of shelly beach deposits, such as that of Portrush. At this period the southern element of the fauna attained its maximum. Finally came elevation of the land, and with the last change of level came the final fluctuation in the character of the animal life, a distinct return towards its former northern character, which has left the fauna as we now find it.

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1881. WRIGHT (JOSEPH).—*Loc. cit.*
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IV.

MAGH ADHAIR, CO. CLARE. THE PLACE OF INAUGURATION OF THE DALCASSIAN KINGS. By THOMAS JOHNSON WESTROPP, B.A.

(PLATE II.)

[Read 13th APRIL, 1896.]

MAGH ADHAIR, now Moyare Park, although one of the best preserved places of inauguration in Ireland, and historic as the spot where our greatest monarch, Brian, was first made king of the little realm of Thomond, has been only noticed, with unaccountable brevity, by our antiquaries and historians,[1] which encourages me to lay before the Academy a description of its site and sketch of its history, with plans of the existing remains.

In the townlands of Corbally and Toonagh, little over two miles north-east from Quin, Co. Clare, the road to Tulla dips into the depression through which flows the little streamlet, known by the name of the Hell river. North of the bridge, over this rivulet, we find a sort of amphitheatre, fenced by crags, and enclosed by a low bank, marked here and there by blocks of stone. In the area of this levelled space rises a large flat topped mound, girt with a fosse and bank. The tumulus (Plate II., fig. 1) measures from 85 to 100 feet on top, and is over 20 feet high; it is in perfect preservation, and does not seem to have been opened. The top has only a few sloe bushes, and a worn slab of limestone, level with the ground, on the north side. A sloping way, with steep sides, leads across the fosse westward to the level of the field. A second but much smaller mound, or rather cairn, of earth and large stones, about 10 feet high and 17 feet on top, rises 30 feet from the last on the brink of the stream. North of the great mound,

[1] The only attempt at description among our predecessors being that in Ordnance Survey Letters, R.I.A., Clooney Parish, Co. Clare, and that only in manuscript. See Annals Four Masters, note on 1599; Royal Society Antiquaries of Ireland, Journal, 1891, note, p. 463.

and within the levelled enclosure, is a boulder of purple conglomerate, embedding pebbles of rose quartz and red porphyry; it is about 4 feet long by 3 feet high, and has, in its upper surface, a small oval basin,[1] apparently hollowed by grinding. Across the stream, 141 feet to the west, in Toonagh, stands a rough slab of limestone, 6 ft. 3 in. high, from 3 ft. to 2 ft. 6 in. wide, and 10 in. thick, forming a pillar in the line of the two mounds and the sloping footway; between it and the stream is a shattered block like the base of a second pillar.

Half a mile towards the S.-W. we find a large stone fort, Cahercalla (Plate II, fig. 2), with the triple enclosure said to characterize a royal residence.[2] It is built of smaller stones and with ruder masonry than the beautiful cahers in north-western Clare and its larger neighbours at Dromoland and Spansil Hill, still it is an interesting ruin, and of sufficiently imposing size. It consists of a massive central cashel, 100 feet internal diameter, with walls 17 feet thick, where best preserved, and still 8 feet high, having a defaced gateway to the east, no stones long enough for lintels remain in the ruin. The second ring is a wall 8 feet and 9 feet thick, and 6 feet high, with gates to S.-E. and S.-W., and a break or gate to N.-E., enclosing a space 214 feet in diameter. The third, and outer, ring-wall has one existing gateway to S.-E., and is 345 feet in diameter; the segment to the N.-W. is levelled. Nihell, the present tenant, states that his grandfather, when engaged on its demolition, was suddenly taken ill, and, fancying he had been "struck" by the fairy inmates of the fort, desisted from his work of destruction; this fortunately saved the caher, and beyond the removal of a small late enclosure in the central ring, no harm has since been done. Several shapeless objects of iron were found in this part of the wall, and thrown into the rubbish, which was heaped against the rampart. This recalls the iron axes, described by Sir William Wilde,[3] found in Caherspeenaun, near Lough Corrib. There are several forts of earth and stone, and an overturned dolmen in the adjoining townlands of Caherloghan and Creevaghbeg, which cannot be considered part of the group at Magh Adhair.

Let me briefly indicate those points in which the remains may be identified with the ancient ceremonial. Besides the elaborate article

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[1] Round basins also occur, with prehistoric remains, in Co. Clare in a block of the dolmen in Newgrove, and another block near the defaced dolmen of Kiltanon, both a few miles distant to the north.

[2] As triple Celtic forts exist outside Ireland, from Scotland to Hungary, the statement needs further examination.

[3] Lough Corrib, p. 245.

by O'Donovan in the "Genealogies and Customs of Hy Fiachra," we have a long account[1] of the inauguration of Cathal Crovderg O'Conor, who died 1224. From it we gather that the cairn or mound, on which the prince stood, had a palisade and gateway, the last guarded during the investiture by three chiefs, a fourth alone ascended the mound to give the rod to the candidate. The other chiefs, and the coarbs of the principal local saints, stood below, holding the prince's arms, clothes, and horse, and afterwards assisting him to robe and remount. The chief faced the north, and, on stepping down from the stone, turned round thrice each way, as is still the custom in Clare, on seeing the new moon. Martin, in his account of "the Western Islands" of Scotland, two hundred years ago,[2] describes a nearly identical ceremony at the inauguration of a Scottish chief: he was placed on a heap of stones, his followers standing round it, and one of his principal friends gave him his father's sword, "and there was a white rod delivered to him at the same time." Then "the chief druid or orator stood close to the pyramid," and made "a panegyric, setting forth the ancient pedigree, valour, and liberality of the family." In the case of the O'Briens we know very little, save that "Macnamara," in whose territory the mound stood, was chief officer. A very doubtful line in only one translation of the "Wars of Torlough" suggests that Macnamara pronounced the titles and descent of O'Brien at a "pillar" among great hosts. This may have been interpolated in the seventeenth century, but is equally likely to preserve a true tradition. An ancient tree also was used in the ceremony at an early period. The inauguration probably took place on the north side of the great mound. The chiefs guarded a gate at the foot of the sloping way; the principal spectators stood in the levelled enclosure; the "orator" recited on the cairn, and possibly the marshal presented the chief to the rank and file of his adherents in the level field beside the pillar. As for the basin-stone its use is not alluded to in the records cited above, but one occurs hollowed in the native rock at Dunadd in Argyllshire, close to the footprint which marks the spot where the Dalriadic kings were "made."[3] The stone at Magh Adhair has no footprint; such a stone, however, exists in Co. Clare at Dromandoora, which, if not of the

[1] Hy Fiachra, p. 432; Kilkenny Society Journal, 1852–3, p. 341; Royal Historical and Archæological Association of Ireland, 1870, p. 349, where the closely analogous mound, cairn, and pillar of Carnfree are described.

[2] Martin's "Western Islands," edition 1703, p. 101.

[3] Soc. Antiq. Scotland, 1878–9, p. 28, paper by Capt. F. Thomas, R.N.

native rock, may have been brought from Magh Adhair.[1] That there were formerly men in Clare willing to expend considerable labour and money in removing any curious stone, is shown by the removals of a huge block from Birr to Cullane by Tom Steele, of the crosses of Kilnaboy and Termon to Kilfenora, of the cross of Kilfenora to Killaloe, and of St. Senan's slab to Kilkee.

History.

The origin of the mound, like that of so many prehistoric remains in Clare, is attributed to the Huamorian Firbolgs in the first century; the "Lay of Carn Chonoill" giving among the names and residences of those legendary warriors that of "Adar at Mag Adair."[2] It is conceivable that the predecessors of the Dalcassians held sacred the grave of some chief, and that their later conquerors marked their victory by using it as a place of inauguration for their own princes,[3] from the fifth to the sixteenth century.

Great obscurity broods over the history of Thomond before the middle of the ninth century. From Brian's reign it abounded in historians and bards, while monastic writers collected the legends of its saints, but strange to say, as regards its rulers, we have not even a consistent list, still less a history of its early kings. Two divergent accounts remain with no name in common, from Conall, son of Eochy Balderg, in the fifth century, to Lorcan, grandfather of Brian, in the ninth. The less known list seems to bear internal marks of genuineness, and fits into the required time; the other is wrong in its chronology and defective in its succession, but it is supported by the few independent facts which do nothing to support its rival. All the princes of both lists can be placed in the Dalcassian pedigree, except, perhaps, Rebechan, son of Mothla (the latter possibly gave his name to Ballyvally, baile ui ṁoṫla, near Killaloe, in which the fort of Boruma stands). Rebechan's contemporary, Lachtna (Lorcan's father), dwelt on Craglea (where the defaced Grianan Lachtna still remains). He appears as ruler of Thomond, at the time of the invasion of Felim,

[1] Proc. R. I. A., vol. x., p. 441. Other footprints, the MacMahons at Mulloch Leaght, Monaghan; Belmont, near Derry; Arzon Morbihan, Brittany; Dunadd, Argyllshire. See also Kilkenny Soc. Journal, v., p. 461: Ordnance Survey of Templemore, p. 441; Delandre's Morbihan, p. 214.

[2] See Revue Celtique, 1894, p. 479, by Dr. Whitley Stokes.

[3] The conquest of Thomond by the Dalcassians seems to have been accomplished between *circa* 380 and 420. "Silva Gadelica," II., pp., 377, 378.

King of Cashel, about 840, in the ancient history preserved in the "Book of Munster." Perhaps, as in later times, Thomond was divided between rival houses, whose records perished in the Danish wars, while the revival of learning under Brian only celebrated that great king's ancestors, and their opponents were only remembered in dry lists like that in the "Book of Ballymote."

In face of such obscurity in the ancient histories, it is little wonder that the records of Magh Adhair only begin late in the ninth century. In 877[1] Flan Sunagh of Cashel invaded Thomond. Having ravaged Munster from Balboruma to Cork, he thought fit to reduce the plain of Magh Adhair, and passing the place of inauguration, stopped, in bravado, to play chess on its green. While thus engaged, King Lorcan fell upon him, aided by the stout chief Sioda, ancestor of the Macnamaras, and, after a three days' skirmish, so entangled him in the country that Flan was glad to surrender, and procure an ignominious retreat across the Shannon.

In the winter of 941 a more friendly stranger, Murchad "of the leather coats," of Aileach, after his daring king hunt round Ireland,[2] brought Callaghan of Cashel and other captives through the friendly state of Thomond, camping a night "on the beautiful cold Magh Adhair." In Brian's reign Malachy, the Ard Righ, overran Thomond in 982, and cut down "the ancient tree of Magh Adhair," after it had been dug from the earth, with its roots. This insult was repeated on a later tree, in 1051, by Aed O'Conor, King of Connaught. After this second disaster we hear little of interest about the place. In Macgrath's "Wars of Torlough"[3] it is often mentioned but in merely a historic formula. O'Brien (Conor, 1240; Brian, 1267; Torlough, 1277; Donough, 1306; Dermot and Murchad, in opposition, 1311; Donough, in opposition, 1313) goes to Magh Eir, and is inaugurated by Macnamara, who proclaims his regal title, and the chiefs and their hosts consent and rejoice. So strongly conservative was public feeling that Lochlan Macnamara, so far as is recorded, without hesitation or protest, inaugurated his enemy Dermot O'Brien, the rival of his friend Murchad, and soon afterwards willingly invested the latter with the chieftainry. The odes on these and later occasions to the reign of

[1] "Book of Munster," R. I. A.; Annals Four Masters, at 877; Todd's "Wars of the Gaedhill with the Gaill," p. cxiii.

[2] "The Circuit of Ireland."

[3] I use the older name as more familiar at present than that of "The Triumphs." See Mr. Standish Hayes O'Grady's translation, pp. 2, 6, 10, 32, 47, 48, 69.

Elizabeth preserved by Macgrath and others tell us nothing definite of the place or ceremonial.[1]

In the T. C. D. list of castles, 1584, Toonagh appears to have been called "Tuanamoyre." I have not met the name again till 1839, when the adjoining field, in Corbally, was still Moy Eir, or Moy Ri, being marked "Moyross Parks" on the six-inch Ordnance Survey, for no apparent reason. I found it Moyare Park in 1891. The older peasantry remembered its great meetings, held down to the time of the famine, no doubt a survival of the ancient fair, or merrymaking, of Eanagh Magh Adhair, which was held as early as 877 : they also said that the mound was a king's grave, and that Cragnakeeroge was not its name, but that of the crags to the north-east. Now, the recent Survey has overlaid all the genuine traditions, and when last year I went again over the ground, it took no small amount of cross-questioning to drive my informant to confess that it was not from his elders, but a "sapper," that he "had heard tell that it was the place where they made a king of Brian Boru."

[1] In "Annals of the Four Masters," 1579, Donnell O'Brien, native chief of Clare, died, and his son Torlough was "installed." This may have been the last formal inauguration.

NOTE ADDED IN PRESS.

The Book of Ballymote explicitly states that Lughad Meann seized on Thomond as an eric for the death of the Ard Righ Crimthann (378). The Annals of Inisfallen, however, say that Lughad's son Connal Eachluadh became King of Munster in 366, which would put back the date of the father's reign to 340. Among contending authorities, it is perhaps more safe to take the later date, as the Dalcassians, evidently, had only obtained the southern part of the present Co. Clare in St. Patrick's time.

V.

ON THE OSMOTIC PRESSURE IN THE CELLS OF LEAVES.

By HENRY H. DIXON, B.A., Assistant to the Professor of Botany, Trinity College, Dublin.

[Read June 8, 1896.]

[COMMUNICATED BY DR. E. P. WRIGHT.]

In a Paper in the Proceedings of this Academy,[1] I have advocated the view that the sap is drawn up in trees in a state of tension, and that under normal conditions this tension is established by means of the osmotic attraction of the cell-sap in the parenchymatous cells of the leaf, exercised on the water in the upper terminations of the water conduits.

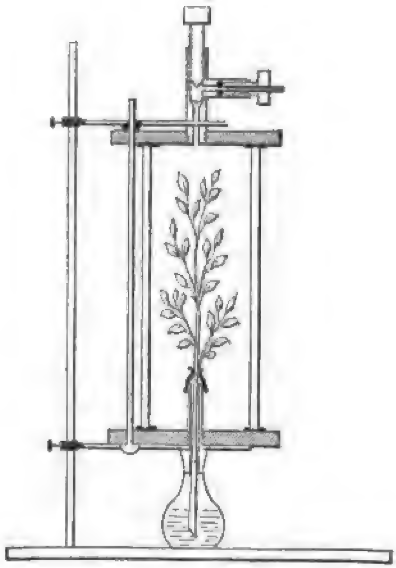
Accordingly, it seemed to me of interest to investigate the osmotic pressures actually existing in the cells of the leaves of plants, in order to discover if these pressures are sufficient to account for the raising of the sap in the conduits by the attraction exercised by the solutions which give rise to these pressures.

Various methods have been adopted in estimating the osmotic pressures in cells. The most usual is to immerse the cell or group of cells to be investigated in solutions of varied concentration, and finding what concentration is necessary to balance the attractive forces of the cell-sap. This may be done by direct examination of the cells, which, when the surrounding solution is too dilute, will expand; because the amount of water attracted into the more concentrated cell-sap will be greater than the amount drawn from it into the surrounding liquid which is more dilute. If, however, the surrounding solution is too concentrated, more water is drawn from the cell-sap than it can attract to itself, and consequently the vacuoles in the cells diminish in size. This leads to a contraction of the protoplasm of the cell, leaving the cell-wall as it contracts, till finally it will form a small ball lying within the cell-wall. It is evident that when the concentration of the surrounding solution is such that it neither causes extension nor plasmolysis, the attractive forces of the solution are equal to the attractive

[1] "Rôle of Osmosis in Transpiration," vol. iii., ser. 3, p. 767, Jan., 1896.

forces of the cell-sap; and we may conclude that the pressure in the cell, if it is freely supplied with water, is equal to the osmotic pressure which this solution could exert. Such a solution is said to be isotonic with cell-sap. Another way of determining when a solution is isotonic with the cell-sap, and so finding the osmotic pressure exerted by the cell-sap, is to observe tentatively what concentration is necessary in a solution which will cause no alteration in form in a piece of turgescent tissue. If the tissue expands in the solution, the latter is too dilute; if it contracts, the solution is too concentrated.

By these methods various osmotic pressures have been determined, $3\frac{1}{2}$ to 21 atmospheres in various tissues; but, so far as I am aware, the pressures obtaining in the tissues of the leaf have not yet been ascertained.



The method I have adopted in this research for estimating the osmotic pressures existing in the leaves is the following:—A branch bearing a number of leaves is enclosed in a strong glass cylinder, capable of resisting high gas-pressure (*e.g.* 50–100 atmospheres), and the pressure is raised in this vessel by means of an air compression-pump, or by attaching it directly to a cylinder containing liquid CO_2. The lower portion of the branch projects from the cylinder and dips into a glass vessel containing a weighed quantity of water. These arrangements are shown in the above figure.

It is evident that when the gas-pressure in the glass vessel surrounding the branch is raised and maintained above the osmotic pressure of the cells of the leaf, that water will be forced from these cells back into the conduits of the branch and into the vessel beneath. This will become apparent in two ways: firstly, by the flagging of the leaf, inasmuch as the rigidity of the leaf is due to the internal pressure of these cells, so that when this pressure is overcome by the external gas pressure the leaf will flag; secondly, by the increase of weight in the vessel beneath containing the water into which the branch dips. For every branch, then, we may expect to find a pressure above which water will be forced back from the leaves into the stem by reason of the squeezing out of the osmotic cells, and below which water will rise through the conduits to the leaves, on account of the osmotic attraction of the cell-sap of the osmotic cells. When this critical pressure itself is maintained around the branch, water will remain stationary in the plant. In carrying out these observations, the form of apparatus I have used consists of a strong glass cylinder of specially well-annealed glass, 50 cms. long, 10 cms. in diameter, and with walls 1 cm. thick. Such a glass cylinder should, according to calculation, be capable of resisting an internal pressure of at least 100 atmospheres. The ends of this glass cylinder are closed by means of two heavy gun-metal castings, which project over the side of the cylinder so as to take three long bolts with nuts, which draw the castings together on the cylinder. Leather-washers, soaked in bees' wax and turpentine, are inserted between the ends which are ground flat and the cylinder to make the joints air-tight. The lower end is perforated centrally, and in the perforation is sealed hermetically a narrow brass tube, about ·5 cm. in diameter, projecting into the cylinder. This tube includes the stem of the plant to be experimented with, the lower end of which projects out of the cylinder while its leaves are enclosed. To make an air-tight connection between the tube and the stem, a stout rubber tube is first bound on to the upper end of the brass tube. The branch is then inserted into the rubber tube, and, before it has been pushed completely down, a portion of it just above the rubber is coated with thick glue, so that when it is shoved down into its final position with reference to the tube, it carries this glue down into the rubber tube. When it is in position, a copper wire is bound tightly round the rubber, and draws it into close contact with the glue. To complete the joint, a little glue is smeared over it. This form of joint is simple and highly satisfactory. The upper end of the cylinder is also perforated centrally to admit the gas coming from the pump or bottle. This is a simple screw-joint, made tight by a leather-washer. To the upper end, and on

the inside, are also attached three hooks, from which are suspended a wire basket, carrying drying materials, and a manometer. The latter consists of a simple, straight glass-tube, closed at one end; the other end dips into a small vessel containing mercury. This tube is marked off with $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, &c., of its length from its closed end, and the position of the mercury index tells directly the pressures in atmospheres. When the upper end of the glass-cylinder is in position, the drying materials and manometer hang in the cylinder. The connection between the glass-cylinder and pump or bottle of CO_2 is made by means of a flexible lead tube with screw couplings.

The results described in this Paper are necessarily only preliminary, as I was unable to procure, by the pump at my disposal, air-pressures above 8–10 atmospheres. Higher pressures were obtained by means of liquid CO_2, as there seemed *à priori* no reason to believe that the presence of CO_2 would falsify the results of experiments which were not continued for a long duration. However, subsequent experimental work showed that the presence of this gas profoundly modified the behaviour of the leaves when exposed to high pressures, and consequently rendered the experiments made with CO_2 of little value in estimating the actual osmotic pressures obtaining in the leaves under normal conditions, although they have an important bearing on the question as to whether the tension is established in the sap directly by evaporative or osmotic actions in the leaf.

I hope immediately to proceed with the investigation of this question (*i.e.* the actual osmotic pressures obtaining in the cells of leaves), as I have been, through the kindness of Mr. S. Geoghegan, C.E., put into a position of dealing with high air-pressures.

In the first experiment, a short branch of *Acer macrophyllum* was sealed into the high-pressure apparatus, and the pressure raised by means of an air-pump, and maintained for fifteen minutes at a pressure between 8 and 10 atmospheres. During this time gas was continually bubbling out from the lower end of the branch, showing that the pressure had been transmitted to the inner tissues. No loss of turgescence, however, of the leaves could be observed.

In a second experiment, a similar branch was exposed to a pressure of 8 or nearly 8 atmospheres during fifteen minutes, and during this time showed no loss of turgescence.

From these two preliminary experiments, it appears that the pressure within the cells of the leaves of *Acer macrophyllum*, which internal pressure confers rigidity on the leaves, was greater than 8 atmospheres. The osmotic attraction which would give rise to this pressure would be capable of drawing up a column of water 240 feet high.

In a similar experiment, a branch of *Cratægus oxyacantha* was exposed to a pressure of about 8 atmospheres for fifteen minutes without showing signs of loss of turgidity.

As the pump I had at my disposal was unable to compress air above a pressure of about 10 atmospheres, I discarded it in favour of using a bottle containing liquid CO_2. This was connected with the high-pressure apparatus by suitable couplings; and, by carefully opening the valve at the mouth of the bottle, the pressure could be adjusted at will to any pressure up to 60 atmospheres. This has the additional advantage that careful observations are possible while raising the pressure, which cannot be done while using the pump unless an assistant is employed.

By means of this arrangement, the pressure was raised round the same branch as was used in the last experiment, to 16 atmospheres, and was maintained at this for fifteen minutes. But even at this pressure the leaves showed no loss of turgescence. When the pressure reached 10 atmospheres, the bubbling of gas through the stem became very marked.

As it appeared possible that a certain amount of collapse of the osmotic cells of the leaves might take place without making itself noticeable by the flagging of the leaves, a number of experiments were made in which the branch dipped into a vessel beneath, which latter was weighed before and after the experiment. Any increase in weight of this vessel would be due to the forcing backwards by the external pressure of the cell-sap contained in the cells of the leaves, which would in turn displace a certain amount of water from the conduits of the branch into the vessel. A decrease, on the other hand, of the weight of the vessel would show that the external pressure had not crushed the osmotic cells, and that they had, in spite of its action, drawn up water from the vessel.

The first experiment of this kind was made on a branch of *Acer macrophyllum*, which bore 14 well-grown leaves. This branch was sealed into the high-pressure apparatus, and kept at a pressure of 8 atmospheres; during one hour of intermittent sunlight this branch drew up 0·1 gr. from the vessel below.

A similar branch, similarly arranged, and exposed to a pressure between 8 and 9 atmospheres, drew up, in one and a-half hour's sunshine, 0·342 gr. of water from the weighed vessel.

From these experiments, it follows, that the osmotic cells of the leaves of *Acer macrophyllum* were able to remain turgescent and draw up water against a pressure of 8 atmospheres. Consequently, the osmotic solution in the cells must be capable of generating a tension

equivalent to 8 atmospheres pressure, by attracting water from the conduits. Such a tension would be capable of drawing up a column of water 240 feet high, provided the column of water was submitted to such conditions that it would not break. Dr. Joly and myself have shown elsewhere that these conditions obtain in the conducting tissues of plants.[1]

All the trees I have experimented with up to the present do not, however, show that their leaves possess such high osmotic pressures when surrounded with CO_2. Thus the specimens of *Cytisus laburnum*, investigated by means of the high-pressure apparatus, showed that they were unable to transpire against an external pressure of more than 6 atmospheres. Above this pressure the leaves begin to collapse, and water is forced back from them into the stem. It is, however, very probable that all the leaves are not put out of activity in transpiration simultaneously. Thus, I have observed, with *Cytisus laburnum*, that the old leaves begin to show collapse by losing their glossy surface, and rolling back from the edges at a pressure of 6–7 atmospheres, while the young, small leaves, which are composed of growing tissues, remain stiff and turgescent, even at 16 atmospheres. This is quite in accordance with Wieler's observations on the internal pressure of the cells of the cambium, which he estimated at 13–16 atmospheres.

A preliminary experiment on *Cytisus laburnum* showed that the leaves of this plant flagged markedly after an exposure of five to ten minutes to a pressure of 16 atmospheres. The flagging in this case is indicated by the folding down of a leaf from the base of its petiole, and the folding back of its leaflets, so that the whole leaf has the appearance of the leaf of a sensitive plant (*Mimosa pudica*) which has been stimulated. Besides these motions, the surface of the leaf loses its gloss and becomes dried-looking, the edges of the leaf roll up, and the expanded portion becomes crumpled. The general appearance of the leaves after twenty minutes exposure to 16 atmospheres is that of a leaf which has been exposed to a high temperature and afterwards dried. Microscopic examination of the cells of these leaves shows the protoplasm contracted from the cell-wall just as it is in plasmolysed cells. This appearance is probably brought about by the cell-wall being pressed in on the protoplasm, and causing the latter to force out its watery contents. When the pressure is relieved, the cell-wall, by virtue of its elasticity, recovers its form, while the protoplasm remains contracted within. The space included by the cell-walls does not, however, attain the dimensions it possessed when the cell was

[1] Phil. Trans. Roy. Soc., vol. 186 (1895), B.

turgescent, as in that case it was distended by internal pressure, and consequently the leaf formed of such collapsed cells is flaccid.

After I had obtained this result, I set about to determine the critical pressure for this plant, *i.e.* the pressure at which *Cytisus laburnum* would cease to draw up water in transpiration, and above which the cells of the leaf would be forced to collapse, and water would be driven back from them into the stem.

(1). In the first experiment, a small branch of this tree carrying 9 leaves was fixed in the apparatus. The pressure was maintained at 16 atmospheres. During one hour of diffused light, while the conditions within the apparatus were kept favourable to transpiration, *i.e.* the space was dried by calcium chloride, 0·950 gr. were forced from the leaves through the stem into the flask below. During the first ten minutes of this experiment the leaves began to flag, and soon showed all the appearances described above.

(2). A branch of the same tree, carrying 12 leaves, some old and some young, was submitted to a pressure of 8 atmospheres. After one hour of bright sunshine the vessel into which the branch dipped was found to have gained 0·400 grs. During this time the old leaves had become flaccid, while the young leaves remained turgid. Even the old leaves did not become markedly flaccid during the first forty minutes of the experiment.

(3). A branch with 8 leaves was exposed to a pressure of 6 atmospheres during one hour of mostly bright sunshine. During this time the leaves showed no signs of becoming flaccid, but the surface lost some of its gloss. On weighing, it was found that the vessel below had lost 0·007 gr. of water. This amount, however, comes within the limits of error of the experiment, and consequently we may assume that neither upward nor downward motion of water occurs in these branches when the leaves are exposed to a pressure of 6 atmospheres. In this experiment, when the pressure was removed, the leaves recovered their gloss.

(4). Against 4 atmospheres, the same branch, in intermittent sunshine, transpired 0·622 gr. in one hour and twenty minutes, while all the leaves remained quite turgid.

At the conclusion of this series on this branch I measured the amount it transpired at normal pressures still surrounded with CO_2 gas, and found it to be 1·244 gr. in one hour and 10 minutes. In air at normal pressure the same branch transpired in one hour 0·966 gr. During these last two experiments, the leaves were slightly faded. These experiments are summarized in the following Table.

TABLE I.

Cytisus laburnum.

	Pressure in Atmospheres.	Conditions of Light.	Duration of Experiment.	Amount of Water Transpired.	REMARKS.
A.	16	Diffused light.	60 minutes.	− 0·950 gr.	A fresh branch with 9 leaves. Old leaves crumpled after 10 minutes; young leaves remained turgescent throughout.
B.	8	Sunshine.	60 minutes.	− 0·400 gr.	Fresh branch with 12 leaves. Old leaves crumpled after 40 minutes; young still turgid.
C.	6	Bright light and sunshine.	60 minutes.	+ 0·007 gr.	A branch which had already been used in experiment D, bearing 8 leaves. At the end of this experiment the leaves had lost some of their gloss.
D.	4	Bright light and sunshine.	80 minutes.	+ 0·622 gr.	Fresh branch with 8 leaves, all of which remained quite turgid throughout.
E.	1	Sunshine.	70 minutes.	+ 1·244 gr.	Same branch as in experiments C and D. Leaves became a little flaccid.
F.	1	Sunshine.	60 minutes.	+ 0·996 gr.	Same branch as in C, D, and E. Leaves still somewhat flaccid.

N.B.—In experiments A.–E. inclusive the branch was surrounded with CO_2; in experiment F. the CO_2 was replaced by air.

The decrease in the rate of transpiration with the increase of pressure which is indicated by these results is, doubtless, more marked than here appears, as it is well known that the rate of transpiration of a branch falls off rapidly from the time of cutting it. In the experiment C at 6 atmospheres which was the second to be made with this branch, this decrease would have been small, but in the succeeding experiments would have become more exaggerated.

It may be noted that the amount transpired at normal pressures was not diminished by the presence of the CO_2 surrounding the leaves.

As it appeared quite possible that different examples of the same species might have different osmotic pressures in their leaves, these branches were all taken from the same individual, and from a height of about 6 feet from the ground. This last precaution is necessary, as it may be that at different heights in the tree, different pressures obtain. I propose investigating these points at a later date.

In this series of experiments there are two sources of error tending to make the critical pressure appear lower than it is in reality:—1st. The mechanical crushing of the conduits themselves owing to the external pressure. When the osmotic cells experience the pressure, they may, without themselves suffering any collapse, move in on the conducting tissues, which, although they are specially provided to resist external pressure as well as internal tension, are elastic to some extent, and consequently will become somewhat contracted. This will expel a certain quantity of water from them into the vessel beneath; and, as the vessel was taken away immediately after the pressure in the glass cylinder was lowered, the conducting tissues may not have had time to reassume their former volume. By this means a quantity of water would be forced back into the vessel and remain there, and would tend to counteract the loss due to transpiration. As the greatest amount of water I have observed forced back in this way from a branch, which was larger than the branch used in these experiments, was about 0·1 gr., as will be seen later, we may place the critical pressure of the branch of *Cystisus laburnum* at 6–8 atmospheres. The second source of error is more difficult to allow for. The presence of the CO_2 surrounding the leaves undoubtedly acts injuriously on the cells of the leaf, so that a leaf which has been surrounded with CO_2 for several hours, sometimes shows a darkened appearance, and collapses at a lower pressure than one which has been put in fresh into the apparatus. With this plant (*Cytisus laburnum*), however, the injurious effects of CO_2 are not so marked nor so rapid in their manifestation as in others. Thus the leaves do not become blackened, nor is the critical pressure markedly lowered, so far as my present observations have gone, within the first six hours immersion in CO_2. All the experiments quoted above were made within this time.

As an illustration of how the CO_2 affects the transpiration and turgescence of the leaves, I will add the two following Tables of experiments on *Tilia americana,* which I have found very sensitive to this gas.

TABLE II.

Tilia americana IN CO_2.

	Pressures in Atmospheres.	Conditions of Light.	Duration of Experiment.	Amount of Water Transpired.	REMARKS.
A.	15–16	Dull.	60 minutes.	– 2·284 gr	Fresh branch with 10 leaves. At the end of 15 minutes collapse of leaves apparent. At the end of the experiment all leaves were shrivelled.
B.	10	,,	40 minutes.	– 0·988 gr.	Fresh branch with 9 leaves; collapse at end of experiment apparent but not marked.
C.	7-10	,,	60 minutes.	– 0·171 gr.	Same branch as was used in A. The leaves were flaccid from beginning to end.
D.	7–8	,,	60 minutes.	– 1·452 gr.	Fresh branch with 8 leaves; collapse but slight. Leaves rolled at edges; unrolling began after the pressure was reduced to normal for 10 minutes.
E.	6	Sunshine.	60 minutes.	– 0·659 gr.	Fresh branch with 12 leaves. No loss of turgescence apparent.
F.	4	Bright diffused light.	45 minutes.	– 0·287 gr.	Same branch as had been used in E., and had been altogether 2 hours in CO_2. After 30 minutes some leaves slightly crumpled.
G.	4	Sunshine and bright light.	60 minutes.	– 0·182 gr.	Fresh branch with 10 leaves. Remained quite fresh and turgescent throughout.
H.	3	Sunshine and bright light.	60 minutes.	+ 0·506 gr.	Fresh branch with 11 leaves. Remained quite turgescent throughout.

TABLE III.

Tilia americana IN AIR.

	Pressure in Atmospheres.	Conditions of Light.	Duration of Experiment	Amount of Water Transpired.	REMARKS.
A.	6	Dull light.	15 minutes.	+ 0·029 gr.	Fresh branch with 4 large leaves.
B.	5	Diffused light.	60 minutes.	+ 0·076 gr.	Fresh branch with 9 leaves. No loss of turgescence apparent.
C.	4	Diffused light.	60 minutes.	+ 0·111 gr.	No loss of turgescence.

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Experiment C. in Table III. is subject to a correction for the elasticity of the branches' conduits. In determining the amount of water transpired, the vessel beneath was placed in a position before the pressure was raised in the glass cylinder and removed for its second weighing, while the pressure was still maintained. Consequently some water was squeezed back from the conduits, owing to their elastic yielding to the pressure, and remained in the vessel, diminishing the amount of transpiration observed. In order to estimate how much ought to be allowed for this, an experiment was made in which the same branch was raised to a pressure of 6 atmospheres for ten minutes. While the pressure was maintained a weighed vessel containing some water was supplied to its protruding end, and then the pressure was lowered to normal atmospheric pressure. After ten minutes the vessel was reweighed and was found to have lost 0·108 gr. due to the elastic recovery of the conduits. When this allowance is made in experiment C., Table III., the amount transpired becomes 0·219 gr., instead of 0·111 gr.[1]

In order to determine whether this elastic contraction of the conduits occurred chiefly in the conduits of the stem or leaf, experiments were made in which a branch was first exposed to a pressure of 6 atmospheres for ten minutes, and while the pressure was still maintained, a weighed quantity of water was supplied to its lower end which protruded from the high-pressure apparatus. The pressure was then immediately lowered, and the branch was left to draw up water from below for ten minutes by means of its elasticity, and the amount which is drawn up is measured by a second weighing. When this amount is compared with the amount drawn up in a similar experiment with the same branch when all the blades of the leaves are removed, it is found that the former is very much greater than the latter quantity. Thus with a branch of *Tilia americana* bearing 11

[1] The fact that the presence of CO_2 in contact with the leaves modifies so profoundly their power of drawing up water against pressure, appears as an additional argument for believing that the osmotic properties of the mesophyll-cells is a more important factor in transpiration than the imbibition or capillary phenomena of the cell-wall. For we can hardly believe that the solution of this gas in the water could possibly reduce the surface-tension sufficiently to account for the difference observed; whereas it is readily comprehensible that the presence of CO_2 would greatly reduce the osmotic pressure of the cells by introducing changes in the primordial utricle (possibly owing to the exclusion of oxygen and consequent intramolecular respiration), or even by forming insoluble substances with the solutions in the vacuoles.

leaves, the first amount was 0·108 gr., while the latter was only 0·02 gr., an amount which approaches the limits of error of the experiment. From this we may conclude that the elastic contraction takes place chiefly in the conduits of the leaves.

I am at present making arrangements of repeating my experiments conducted in CO_2 with air, in view of the difference in the critical pressure obtained in the two methods.

V.

THE ETHNOGRAPHY OF BALLYCROY, COUNTY MAYO.

By CHARLES R. BROWNE, M.D.

(PLATES III. AND IV.)

[Read 11th MAY, 1896.]

CONTENTS.

I.—INTRODUCTION.

THE usual local ethnographic survey undertaken anually as part of the work of the Anthropological Laboratory, Trinity College, was last summer carried out by me in the district known as Ballycroy, a portion of the barony of Erris, Co. Mayo, which was considered worthy of study, owing to the differences, said to exist, between its inhabitants and the natives of other parts of the same barony.

As the Mullet, Iniskea, and Portacloy were the subjects of last year's inquiry this may be considered as a supplementary survey, practically completing the barony of Erris, and for this reason such

census returns as apply to the whole of Erris, taking no account of smaller divisions, are quoted in this Paper.

Though, in some ways, not at all so primitive in habits and modes of life as the people of the districts previously described, the population of this district is worthy of notice, as being originally a colony from another part of Ireland, which have remained practically unmixed with the local peoples until the present day.

In his extremely valuable and interesting little work on Erris, Mr. Knight makes a statement which even now, after the lapse of sixty years, needs but little qualification, when he says: "I have said that there was a difference between the inhabitants of this district and the other parts of Erris. The Irish Channel scarcely makes such a difference between the inhabitants of the sister islands as Tulloghaan Bay makes between Ballycroy and Erris proper."

The facilities and difficulties experienced in carrying out the work of inquiry differed considerably from those experienced in other localities, the greatest of the latter being the extremely scattered nature of the population, and the absence of any assemblage of houses large enough to be termed a village or even a hamlet.

II.—PHYSIOGRAPHY.

Ballycroy has tolerably well-defined boundaries, it lies along the coast-line, about eighteen miles south of the Mullet, and is separated from the rest of Erris; Tulloghaan Bay and the Owenmore river form its northern boundary; and the mountains of Maamthomas, Nephin Beg, and Gorslieve bound it on the east and south-east. The length of its sea-coast, counting indentations, is about forty-seven miles (this estimate, however, includes the islands of Annagh and Inisbiggle, and some smaller islets which do not belong to Ballycroy proper).

As a rule the waters are shallow all along the coast, which, though rising in some places to a considerable height, is, as a rule, rather low.

The surface of the district does not present any very great variety; it gradually slopes upwards from the sea-coast to the mountains, and has a more or less hilly or rolling surface, with an average elevation of not more than two hundred feet above the sea-level. A large portion of this surface is bog, most of it still in a virgin state. Mr. Knight estimated that of the area of over 30,000 acres, about 3075 would be "*green acres.*" The underlying rock is mica slate or

granular quartz. In the lower parts of the district there are several lakes.

The climate is very mild, there being but little frost or snow in winter; but, as might he expected from the situation of the locality, it is very moist, rains being both heavy and frequent, and storms of great violence often sweeping over the region from the westward. Vegetation flourishes well, owing to the mildness of the climate, a good example of which is the fact that palms and other exotics grow well in the open air in the grounds of General Clive at Claggan, in the southern part of the district. Trees of various kinds flourish in the valleys, and wherever sheltered from the prevailing winds. In the valleys among the mountains, the red deer used, at one time, to be met with in some numbers, but, within the past forty years, they have become quite extinct. Wild fowl, in great numbers, visit the lakes and coast-line in the winter-time, among them wild swans, which principally frequent Lough Fahey, near the coast. The number of the smaller wild animals is very considerable.

III.—Anthropography.

1. *Methods.*—The modes of measurement and of taking observations were precisely the same as those employed in the visit to the Mullet district in 1894, the observation forms and nigrescence cards were also of the same patterns; as all these have been described in previous reports, they need no further mention here.

The instruments employed were those used in the other surveys, with one exception, a "Trinity" tripod camera of "half-plate" size, made by Messrs. Curtis Bros., of Suffolk-street, Dublin. This instrument, which is very light, strong, and compact, did its work well, and stood a good deal of rough handling, without suffering in the least. The "Trinity" hand-camera by the same makers, which did good work the previous year, continued to do well, though the weather was not very suitable for "snap-shot" work, and the brand of plates used was not quite satisfactory. The value of a hand-camera for field-work, as an aid to, or substitute for the heavier and more slow tripod stand-camera can hardly be overrated, as it can be employed for taking the portraits of persons who cannot be induced to get photographed by the other instruments, and it can also be used on very rough ground or in high winds, where the other camera could not be kept steady; for objects in motion, and local customs or occupations, it is invaluable. The chief difficulties met with were: the

scattered state of the population, and the absence of villages in which many people might be seen together, also the difficulty in reaching many parts of the district, owing to the paucity of roads and the soft boggy nature of much of the land. In some instances (more than a third of the whole) the men measured were at work in the bogs preparing the way for a new road, a long distance from any public highway, and the weather being broken and rainy, the bog was soft, making walking difficult.

Here, as in some other places previously described, the custom of cropping the hair rather close made it very difficult to ascertain the exact shade of colour.

A considerable number of photographs were taken, including portraits and groups, illustrative of the customs, modes of life, and habitations of the people, besides several views showing the nature of the surface and coast-line, and several of the antiquities of the district.

2. *Physical Characters.*

(A.) *General characters.*—There is, on the whole, a great uniformity of appearance in the people of this district, though, on closer inspection, at least two distinct types may be discovered.

The general appearance of the people is rather pleasing, many of the men are handsome, and the women, too, are often good-looking, but, as observed in the reports on the other districts surveyed, both sexes seem to age rather rapidly, and some of the men become wrinkled very early.

Stature and bulk.—The men are usually stoutly built, and of about the middle stature, though extremes, in this respect, are more common than observed in the Mullet or the Inishkea islands.

A few men of small stature were met with, and about an equal number of tall men.

The average height of the fifty men measured was 1721 mm., or a little under 5 ft. 8 in., the extremes were 1576 mm. (5 ft. 2 in.) and 1838 mm. (6 feet).

The shoulders are broad and square, and the upright carriage of many of the men is very noticeable.

Head.—The head is massive and well-shaped, usually broad just above the ears; it is usually either brachycephalic or mesaticephalic, though a few cases of dolichocephaly were observed, one of a very marked degree (70·7, or when reduced to the cranial standard, 68·7),

which might be fairly called scaphocephalic. The mean cephalic index, when reduced to the cranial standard by the subtraction of two units, is 78·5 (or almost exactly that of the natives of Inishbofin).[1]

The cranial curve rises to a fair height (mean altitudinal index, 65·6), sweeps evenly backwards, and descends rather abruptly to the external occipital protuberance.

The forehead is broad, seldom receding, and not very high; the skin is often a good deal wrinkled, even in comparatively young men, but not so much so as in the case of the fishing populations. The eyebrows overhang the eyes considerably, and are thick and rather level. The glabella and superciliary ridges are often large

Face.—The face, though often long, is rather oblong in outline, owing to the breadth of the jaws in the bigonial region. The cheekbones are, as a rule, prominent. The ridge or fold of skin at the root of the nose is not as common, nor when seen, of as large size as in the men of the fishing populations. The eyes have usually blue or light grey irides, seldom hazel or brown, but it should be noted that the percentage of "light" eyes in adults, 78·7 (a much lower figure than observed in any of the districts yet reported on) shows a larger proportion of dark-eyed people in the population of Ballycroy.

The eyes are deeply set, and are placed rather wide apart; there are often wrinkles around them, as is generally observable in the west. The eyelashes are dark and long.

The nose is straight usually, sometimes sinuous, seldom aquiline or *rétroussé.* The mean nasal-index is 63·9.

The mouth is large, and the lips of medium thickness. The teeth are, when not spoiled by excessive smoking, small, white, and very even. The angles of the jaw are rather pronounced and square, which gives an oblong outline to the face when viewed from the front. The chin is often prominent. The ears are usually flat, but in about a third of the cases observed are outstanding. But few abnormalities of this organ were observed; in twenty-two instances, out of the fifty men noted, the lobule was attached; in one case it was absent, and in another extremely small, but great variations in the form of the pinna, such as were observed in some parts of the Mullet, were not noticeable in Ballycroy.

Skin.—The complexion is fair or ruddy, seldom freckling; sallowness is not common, even in those with dark eyes. As noted in other sections, wrinkles seem to come rather early.

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[1] Of the fifty men measured, 18 were brachycephalic, 26 mesaticephalic, and 6 dolichocephalic.

Hair.—The hair is usually a dark brown; next, in order of frequency, comes the lighter shades of brown; then black, which is commoner here than in the Mullet; then fair, and lastly red. The growth of the hair is fairly abundant, though baldness is not uncommon. It is often wavy or curly. The beard is usually somewhat lighter in colour than the hair of the scalp, and, if allowed to grow naturally, seems to have, in many cases, a tendency to fork at the end.

The nigrescence index, for the adults of both sexes, is 57·71, showing a larger percentage of dark and black hair than in any district as yet surveyed.

The foregoing description is, of course, a general one, applying only to the prevailing type; there is, however, a second type not unfrequently met with, the chief characters of which are, long oval face, with but slightly marked angles to the jaws, less prominent cheek bones and sharper features.

The figure seems to be slighter in youth, but to exhibit a tendency to put on flesh with advancing years. The hair, in this type, is usually lighter than the prevailing tint, but may be of any colour, owing to admixture.

The various authors who have written respecting the men of Ballycroy are fairly agreed concerning them. They usually describe the people as of below the medium height, dark-haired, and athletic.

In Knight's "Erris in the Irish Highlands,"[1] they are thus described: "This colony of Ulstermen, at whatever time they settled in this country, still retain the ancient dialect of language used in the north; intermarry almost exclusively with one another; a hardy, low-sized, dark-featured race; bold, daring, and intrepid in danger; not good-tempered, but hospitable to an extreme." And again: "The mountaineers are remarkably stout and healthy. . . . The journeys they make are quite extraordinary. A fellow in Ballycroy thinks nothing of taking a ten-gallon keg of whisky, weight 150 lbs. at least, and crossing the mountains to Newport, a distance of twenty miles, sells it, and returns home in the evening, without the slightest appearance of fatigue, and carelessly resumes his usual occupation."

Maxwell[2] gives the following description of the peasantry of Co. Mayo, including the people of Ballycroy, his own locality:—

"In personal appearance the western peasantry are very inferior to those of the other divisions of the kingdom. Generally they are

[1] Page 106.

[2] "Wild Sports of the West," chap. xliii.

undersized, and by no means so good-looking as their southern neighbours; and, I should say, in other points they are equally deficient.[1] To overcome their early lounging gait and slovenly habits is found by military men a troublesome task; and while the Tipperary man speedily passes through the hands of the drill-sergeant, the Mayo peasant requires a long and patient ordeal before a martial carriage can be acquired, and he be perfectly set up as a soldier. These defects once conquered, none are better calculated for the profession. Hardy, active, patient in wet and cold, and accustomed to indifferent and irregular food, he is admirably adapted to endure the privations and fatigue incident to a soldier's life on active service, and in dash and daring no regiments in the service hold a prouder place than those which appertain to the kingdom of Connaught."

Though there are some men of small stature in the community, there are also some above the middle height, and the majority are of about the middle stature.

Ballycroy being pre-eminently *the* district of County Mayo, inhabited by a colony of Ulster origin, it may not be out of place to repeat here what was written about people of similar origin in the Mullet, that there appears to be no foundation whatever for the statement made originally by an anonymous writer, and quoted repeatedly since by several writers both in this country and abroad, to the effect that the descendants of the dispossessed Ulster tribes, who settled in the counties of Sligo and Mayo, have through intermarriage and deficient food dwindled to an average height of five feet two inches, and become prognathous, pot-bellied, and utterly degenerate. As before stated, the average stature of the fifty men measured was 1721 mm., or barely under 5 ft. 8 in.; no selection whatever was practised beyond excluding some ungrown young lads; and this average is perhaps a little below the true figure, as it was said by several of the people that most of the best grown men were away working as migratory labourers in England. Only three men whose height was less than five feet three and a half inches were met with, and they seemed to be exceptional cases. Only one dwarf is known in the district.

[1] This is a matter of opinion, in which I can by no means agree with this author.

CEPHALIC INDICES, CORRECTED FOR COMPARISON WITH SKULLS.

No.	Index.	A. Corrected Indices.	
4	86.8		
12	85.9		
49	85.9		
48	85.6		
10	85.0		
7	84.5		
3	84.2		
15	84.2		
5	83.9	18 Brachycephalic.	
45	83.8		
34	83.2		
37	83.0		
32	82.9		
41	82.8		
20	82.5		28 Brachycephals.
16	82.3		
43	82.3		
13	82.0		
39	81.4		
40	81.4		
8	81.3		
28	81.2		
27	80.9		
31	80.7		
46	80.6		
1	80.6		
2	80.4		
14	80.4		
33	79.8		
36	79.8		
17	79.4		
44	79.4	26 Mesaticephalic.	
24	79.2		
6	79.1		
11	79.0		
23	79.0		
38	78.8		
50	78.0		20 Mesaticephals.
22	77.8		
29	77.8		
18	77.6		
47	77.6		
9	77.5		
42	77.0		
35	76.8		
21	76.5		
26	75.0		
30	75.0	6 Dolichocephalic.	
19	74.3		2 Dolichocephals.
24	70.7		

(B.) ***Statistics of Hair and Eye Colours:—***

ADULTS.—I. *Males.*

HAIR.	EYES.			Totals.	Percentage Hair Colours.
	Light.	Medium.	Dark.		
Red, ..	4	1	1	6	3·97
Fair, ..	17	—	—	17	11·25
Brown, ..	42	3	—	45	29·81
Dark, ..	44	17	4	65	43·05
Black, ..	12	2	4	18	11·92
Totals, ..	119	23	9	151	100·00
Percentage Eye Colours,	78·81	15·23	5·96	100·00	—

Index of Nigrescence, . . 51·67.

ADULTS.—II. *Females.*

HAIR.	EYES.			Totals.	Percentage Hair Colours.
	Light.	Medium.	Dark.		
Red, ..	3	—	—	3	3·75
Fair, ..	2	—	—	2	2·50
Brown, ..	24	3	—	27	33·75
Dark, ..	32	5	3	40	50·00
Black, ..	1	3	4	8	10·00
Totals, ..	62	11	7	80	100·00
Percentage Eye Colours,	77·5	13·75	8·75	100·00	—

Index of Nigrescence, . . . 63·75.
Combined Index (both sexes), . 57·71.

Children.—I. *Boys.*

Hair.	Eyes.			Totals.	Percentage Hair Colours.
	Light.	Medium.	Dark.		
Red, ..	1	—	—	1	2·86
Fair, ..	3	—	—	3	8·57
Brown, ..	13	1	—	14	40·00
Dark, ..	13	2	—	15	42·85
Black, ..	1	1	—	2	5·72
Totals, ..	31	4	—	35	100·00
Percentage Eye Colours,	88·58	11·42	—	100·00	—

Index of Nigrescence, . . 42·76.

Children.—II. *Girls.*

Hair.	Eyes.			Totals.	Percentage Hair Colours.
	Light.	Medium.	Dark.		
Red, ..	1	—	—	1	4·55
Fair, ..	2	—	—	2	9·08
Brown, ..	5	—	—	5	22·73
Dark, ..	8	3	2	13	59·09
Black, ..	—	—	1	1	4·55
Totals, ..	16	3	3	22	100·00
Percentage Eye Colours,	72·72	13·64	13·64	100·00	—

Index of Nigrescence, ... 54·54.
Combined Index (both sexes), . 48·65.

(c.) *Physical Proportions.*—The proportions borne by the main measurements to the stature (taken as 100) are given in this Paper as in its precursors. They are considerably different from those of the inhabitants of the localities previously visited, and especially from those of the people of the neighbouring district of the Mullet, and from the islanders of Iniskea.

Face.

The face, though long in proportion to the stature, is, on the average, shorter comparatively than is the case in Aran, Inishbofin, or the Mullet and Inishkea. The average is 7·29 (canon 6·60), as against 7·61, 7·48, and 7·36, respectively, for the other localities. The extremes noted in Ballycroy are 6·52 and 8·68.

Upper Face.—The mean is 4·16, as against 4·42 for Inishbofin, and 4·30 for the Mullet, thus showing the comparative shortness.

Nose.—As has been noted previously, this does not bear a very constant proportion to the stature. The extremes are 3·56 and 2·59, and the mean 3·25, or something less than the canon (3·30).

Sitting Height.

The sitting height appears to be somewhat greater proportionally than in the Mullet, &c., as the mean is 53·05, as against 51·33. The extremes were 50·71 and 56·60.

Upper Limb.

Span.—No case of a span-stretch less than the stature was met with here; in fact, in nearly all cases this measurement is proportionately very great. The average for the fifty men measured is 105·75, with extremes of 111·04 and 101·18. As the limbs are not exceptionally long, this shows considerable stoutness of build. The mean for Aran was 101·94 (not much above the Ballycroy minimum); for Inishbofin, 104·95; and for the Mullet, &c., 104·36.

Hand.—The hand is decidedly short, the mean being only 11·31, but varying from 10·28 to 12·08: this mean is about the same as that for Inishbofin (11·33).

Forearm.—This section of the arm is proportionately long, the mean being 15·30, with extremes of 16·28 and 14·02. The forearm is thus shorter than in the Mullet, and intermediate between it and Inishbofin (15·03) and Aran (15·18).

(D.) *Detailed List of Measurements:—*

No.	Indices.						Proportions to Stature.—Height = 100.						
	Cephalic.	Height.	Facial.	Bigonial.	Alveolar.	Nasal.	Hand.	Forearm.	Span.	Height Sitting.	Face.	Upper Face.	Nose.
1	80·6	68·1	98·5	78·9	93·7	57·9	11·07	15·28	105·62	51·79	7·50	4·37	3·24
2	80·4	64·9	103·0	80·6	96·8	71·0	11·45	15·87	108·93	51·12	7·49	4·19	3·07
3	84·2	64·2	120·3	91·1	100·0	63·3	10·83	14·56	104·54	52·71	7·16	3·84	2·85
4	86·8	69·2	109·2	90·8	93·8	54·1	11·39	15·80	110·61	51·35	7·33	4·35	3·44
5	83·9	70·4	113·8	84·6	100·0	55·6	11·00	15·62	106·15	50·71	7·69	4·26	3·20
6	79·1	66·3	121·2	92·4	99·0	78·0	11·05	16·02	103·53	52·60	6·52	3·48	2·76
7	84·5	62·9	122·0	103·4	100·0	61·5	11·86	15·54	107·38	53·96	7·14	4·22	3·15
8	81·3	62·5	120·3	91·5	101·0	70·6	12·08	15·24	107·91	53·04	7·02	4·29	3·04
9	77·5	64·9	104·9	88·5	103·3	75·0	11·05	14·97	104·31	56·60	7·16	4·31	3·05
10	85·0	72·0	104·2	76·4	89·4	50·0	10·95	14·66	102·65	52·79	8·68	4·51	3·49
11	79·0	62·6	108·1	85·5	102·2	51·8	11·01	14·80	104·50	52·69	7·34	4·44	3·19
12	85·9	67·7	116·6	91·3	92·4	63·0	11·26	14·94	105·85	51·29	6·99	4·22	3·20
13	82·0	69·4	104·4	87·6	103·2	60·3	10·89	14·80	102·01	51·90	7·45	4·23	3·15
14	80·4	64·8	110·4	82·1	93·0	51·7	11·42	14·53	104·32	51·30	7·94	4·68	3·44
15	84·2	71·3	115·9	90·5	96·8	66·0	11·00	14·75	101·18	54·35	7·41	4·30	3·11
16	82·3	64·1	104·4	85·3	99·0	63·6	11·98	14·46	107·26	55·04	8·02	4·72	3·24
17	79·4	66·5	119·3	98·2	100·0	72·9	11·74	14·52	106·30	54·51	7·05	3·96	2·97
18	77·6	65·5	115·4	92·3	101·9	70·4	11·27	15·28	107·91	52·44	6·94	4·06	2·88
19	74·3	62·4	108·4	91·6	94·9	57·9	11·72	16·15	105·48	51·19	7·45	4·43	3·24
20	82·5	68·0	104·5	90·9	98·0	57·4	11·15	15·41	106·40	54·65	7·67	4·30	3·14
21	76·5	64·2	125·2	99·1	98·0	65·5	11·90	16·25	110·00	53·45	6·84	3·92	3·45
22	77·8	63·9	110·6	89·4	100·0	70·0	10·68	15·72	106·76	51·61	7·29	4·09	3·56
23	79·0	61·0	120·7	90·9	103·2	70·0	11·23	15·17	104·10	52·50	6·79	3·82	2·81
24	79·2	64·4	109·4	84·4	103·1	60·3	11·55	15·34	106·77	52·74	7·47	4·49	3·38
25	70·7	61·6	101·6	89·6	98·9	61·1	10·98	14·95	111·04	55·13	7·57	4·60	3·19
26	75·0	63·5	105·6	86·4	102·2	58·0	11·48	15·80	104·55	52·48	7·35	3·97	2·92
27	80·9	68·6	118·7	94·3	103·2	64·7	11·07	16·07	103·21	54·46	7·32	4·22	3·04
28	81·2	66·0	97·9	75·8	103·1	71·4	11·78	14·89	104·96	50·74	7·91	4·20	3·06
29	77·8	68·2	109·2	83·1	103·0	59·6	11·64	15·69	102·82	54·40	7·35	4·24	2·93
30	75·0	63·9	112·2	91·1	100·0	64·2	11·39	15·13	105·58	55·41	7·08	4·37	3·05
31	80·7	63·5	110·6	86·2	101·1	64·7	10·28	14·94	105·11	53·80	7·00	4·21	2·90
32	82·9	68·4	107·1	86·6	98·9	62·0	11·68	15·57	105·39	54·73	7·61	4·67	3·00
33	79·8	65·7	109·5	83·5	102·0	50·9	11·60	14·66	108·65	52·14	7·34	3·93	3·18
34	83·2	63·9	120·3	96·6	103·2	73·5	12·06	15·12	110·00	52·65	6·94	4·24	2·90
35	76·8	64·6	104·5	83·0	104·1	70·0	11·08	15·34	104·14	54·05	7·76	4·37	2·92
36	79·8	63·6	116·0	90·8	98·9	75·6	11·18	15·22	106·61	51·50	6·97	3·69	2·64
37	83·0	66·0	121·2	95·8	93·3	72·3	11·71	15·51	110·13	54·43	7·47	4·11	2·97
38	78·8	62·2	120·0	91·7	104·5	68·6	11·18	15·43	101·61	—	6·92	3·86	2·94
39	81·4	61·9	117·4	97·5	102·2	62·0	11·63	16·28	105·41	51·74	7·03	4·19	2·91
40	81·4	64·4	108·6	92·2	102·4	67·3	11·58	15·67	107·49	52·92	7·49	4·09	2·86
41	82·8	70·4	120·3	90·7	100·0	75·6	11·05	15·28	103·03	53·63	6·76	3·72	2·59
42	77·0	65·0	115·7	89·3	104·4	61·7	11·19	14·64	106·62	53·54	7·03	3·88	2·75
43	82·3	65·1	115·3	91·2	100·0	65·1	10·95	14·52	106·05	53·03	7·20	4·27	2·82
44	79·4	63·4	118·1	92·9	100·0	56·4	11·42	16·16	110·07	52·40	7·43	4·04	3·22
45	83·8	67·0	110·8	86·6	100·0	62·3	11·55	16·26	106·32	52·76	7·30	4·14	3·05
46	80·6	64·8	117·7	87·1	102·1	64·0	10·57	16·35	102·92	53·53	7·24	4·14	2·92
47	77·6	66·3	111·4	86·9	97·9	61·2	11·12	14·02	103·62	53·37	7·22	4·02	2·90
48	85·6	68·6	123·1	104·2	98·9	63·5	11·64	15·42	104·29	53·28	7·60	3·84	2·94
49	85·9	62·8	118·3	90·0	101·1	66·7	11·30	15·63	104·98	54·04	7·02	4·45	2·98
50	78·0	63·5	109·1	86·0	92·8	56·6	11·01	14·48	102·61	52·94	7·00	4·06	3·07
Mean	80·5	65·6	112·6	89·4	101·4	63·9	11·31	15·30	105·75	53·05	7·29	4·16	3·25

No.	Name.	Age.	Locality of — Father's people.	Locality of — Mother's people.	Eye Colour.	Hair Colour.	Skin.	Ears.
1	*Conway, Anthony	30	Ballycroy	Ballycroy	blue	fair	ruddy	Outstanding
2	*Cleary, Denis, .	30	,,	,,	dark-grey	dark	ruddy	Flat
3	Keane, Anthony,	24	,,	,,	blue	brown	ruddy	Outstanding, lob attached
4	*MacMenamon, John,	45	,,	,,	blue	brown	ruddy	Flat
5	Lenahan, Patrick,	22	,,	,,	light-grey	dark	pale	Flat
6	*Cleary, Michael, .	38	,,	,,	dark-grey	black	ruddy	Outstanding, lol attached
7	*Sweeney, Maners	30	,,	,,	blue	fair	pale	Outstanding, lol attached
8	*Campbell, John, .	25	,,	,,	dark-grey	dark	pale	Outstanding, lol absent
9	*Doran, Hugh, .	—	,,	,,	blue	fair	pale	Flat, lobes attacl
10	*Cleary, John, .	25	,,	Newport, Mayo	blue	fa r	ruddy	Flat
11	*Keane, Philip, .	41	,,	Ballycroy	blue	dark	pale	Flat
12	*Conway, James, .	40	,,	,,	dark-grey	dark	ruddy	Flat
13	*Cleary, James, .	35	,,	Newport	blue	fair	ruddy	Flat
14	*Corrigan, James,	40	,,	Ballycroy	dark-grey	dark	pale	Flat
15	*Cleary, Bertie, .	19	,,	Newport	dark-grey	dark	pale	Flat
16	*Sweeney, James,	28	,,	Ballycroy	green	dark	pale	Flat
17	Tighe, Thomas, .	30	,,	,,	green	dark	ruddy	Flat
18	*Cleary, Martin, .	35	,,	,,	blue	black	ruddy	Flat, lobes attacl
19	M'Gowan, Roger,	24	,,	,,	light-grey	dark	ruddy	Flat
20	Conway, Ezra, .	33	,,	Sligo	blue	light-brown	ruddy	Flat, lobes attacl
21	Ginty, Patrick, .	22	,,	Ballycroy	blue	black	ruddy	Flat, lobes v small, & attacl
22	*Murray, Patrick,	35	,,	,,	light-grey	dark	pale	Flat
23	*Kane[1], John, .	22	,,	,,	green	brown	ruddy	—
24	*Conway, Michael,	42	,,	,,	blue	fair	ruddy	Flat
25	Bradley, Daniel, .	45	,,	,,	dark-grey	dark	ruddy	Outstanding

Note.—All those whose names are marked with an asterisk (*) claimed th

…alic.	Facial.				Nasal.			Auricular Radii.			Height.		Forelimb.		
Breadth.	Face length.	Upper Face length.	Breadth.	Bigonial Breadth.	Length.	Breadth.	Internal Bi-ocular brdth.	Vertical.	Nasal.	Alveolar.	Standing.	Sitting.	Span.	Hand.	Forearm.
154	132	77	130	104	57	33	32	130	95	89	1761	912	1860	195	270
156	134	75	138	108	55	39	30	126	93	90	1790	915	1950	205	284
160	123	66	148	112	49	31	30	122	91	91	1717	906	1795	186	250
158	130	77	142	118	61	33	31	126	96	90	1772	910	1960	202	280
156	130	72	148	110	54	30	32	131	90	90	1690	857	1794	186	264
155	118	63	143	109	50	39	34	130	97	96	1810	952	1874	200	290
164	118	70	144	122	52	32	30	122	90	90	1653	892	1775	196	258
156	118	72	142	108	51	36	34	120	93	94	1680	891	1812	203	256
148	122	68	128	108	48	36	32	124	90	93	1576	892	1644	174	236
170	144	80	150	110	62	31	30	144	94	84	1773	936	1820	194	260
154	124	75	134	106	54	28	28	122	92	90	1689	890	1765	186	250
170	127	71	148	116	54	34	34	134	92	85	1673	958	1771	199	250
169	137	78	153	120	58	35	32	143	95	93	1838	954	1875	200	272
160	134	79	148	110	58	30	34	129	100	93	1687	866	1762	193	245
170	126	73	146	114	53	35	36	144	95	92	1700	923	1720	187	250
158	136	80	142	116	55	35	34	123	97	98	1695	933	1818	203	245
154	114	64	136	112	48	35	32	129	97	97	1618	882	1720	190	245
160	130	76	150	120	54	38	34	135	104	106	1872	981	2020	212	286
150	131	78	142	120	57	33	30	126	98	93	1758	910	1912	206	284
160	132	74	138	120	54	31	32	132	98	96	1720	940	1830	191	264
156	115	66	144	114	58	38	33	131	99	97	1680	908	1848	200	273
151	123	69	136	110	50	35	30	124	91	91	1686	870	1800	180	265
158	121	68	146	110	50	35	34	123	95	98	1780	936	1853	200	270
160	128	77	140	108	58	35	30	130	96	99	1714	904	1830	198	263
140	128	74	130	114	54	33	34	122	91	90	1694	934	1881	186	252

…eir families originally came from "the North." [1] In Irish, O'Cahan.

No.	Name.	Age.	Locality of — Father's people.	Locality of — Mother's people.	Eye Colour.	Hair Colour.	Skin.	Ears.
26	Lenehan, John, .	70	Ballycroy	Ballycroy	light-grey	dark	pale	Outstanding, l attached
27	*Murray, James, .	45	"	"	light-grey	dark	pale	Flat
28	*M'Gowan, Bryan,	—	"	"	dark-grey	black	pale	Flat
29	Bradshaw, Michl.	30	"	"	blue	brown	ruddy	Outstanding, l attached
30	*Ginty, Thomas, .	—	"	"	light-grey	dark	ruddy	Outstanding, l attached
31	*Conway, Peter, .	22	"	Newport	blue	black	ruddy	Outstanding
32	*Gaughan, John, .	23	"	Ballycroy	light-grey	brown	ruddy	Flat
33	*O'Boyle, Andrew	33	"	"	light-grey	black	ruddy	Outstanding
34	*M'Guire, James,	—	"	"	blue	brown	ruddy	Outstanding
35	*Lenehan, Patrick,	50	"	"	light-brown	black	dark	Outstanding
36	Gilroy[1], Michael,	20	"	"	dark-grey	dark	ruddy	Outstanding
37	*Kane, Patrick, .	25	"	Newport	light-grey	fair	ruddy	Outstanding, l attached
38	*Conway, Neal, .	58	"	Ballycroy	light-grey	black	pale	Outstanding, l attached
39	*M'Gowan, Patrick	—	"	"	light-brown	black	ruddy	Flat
40	*Conway, Patrick,	40	"	"	light-grey	black	ruddy	Flat
41	*Keane, Bernard, .	20	"	"	blue	brown	pale	Outstanding, l attached
42	Finn, Edward, .	55	"	"	blue	brown	pale	Flat
43	*Cafferky, Michael	35	"	"	blue	black	pale	Flat, lobes attac
44	*Conway, Michael	35	"	"	blue	fair	ruddy	Flat, lobes attac
45	*Conway, James, .	40	"	"	green	red	ruddy	Flat, lobes attac
46	*Cafferky, Hugh, .	46	"	"	blue	brown	ruddy	Flat, lobes attac
47	*Cafferky, James, .	19 ?	"	"	blue	black	ruddy	Flat, lobes attac
48	*Sweeny, Loughlin	20	"	"	blue	brown	ruddy	Outstanding
49	*Conway, Peter, .	25	"	"	blue	fair	ruddy	Flat
50	*Conway, Hugh, .	19	"	"	green	dark	ruddy	Outstanding

NOTE.—All those whose names are marked with an asterisk (*) claimed that their families originall

...PHALIC.		FACIAL.				NASAL.			AURICULAR RADII.			HEIGHT.		FORELIMB.		
	Breadth.	Face length.	Upper Face length.	Breadth.	Bigonial Breadth.	Length.	Breadth.	Internal Bi-ocular brdth.	Vertical.	Nasial.	Alveolar.	Standing.	Sitting.	Span.	Hand.	Forearm.
2	144	125	68	132	108	50	29	32	122	93	95	1715	900	1793	197	271
8	152	123	71	146	116	51	33	30	129	93	96	1680	915	1735	186	270
7	160	145	77	142	110	56	40	39	130	97	100	1833	930	1924	216	273
8	154	130	75	142	108	52	31	31	135	99	102	1770	963	1820	206	276
8	156	123	76	138	112	53	34	30	133	99	99	1738	963	1835	198	263
2	155	123	74	136	106	51	33	30	122	94	95	1760	947	1850	181	263
3	160	127	78	136	110	50	31	31	132	90	89	1670	914	1760	195	260
8	158	127	68	139	106	55	28	31	130	98	100	1730	902	1880	201	264
2	168	118	72	142	114	49	36	34	129	95	98	1700	895	1870	205	267
8	152	132	75	138	106	50	35	33	128	98	102	1715	927	1786	190	263
8	158	119	63	138	108	45	34	33	126	95	94	1708	872	1823	191	260
8	156	118	65	143	113	47	34	34	124	90	84	1580	860	1740	185	245
3	152	120	67	144	110	51	35	32	120	88	92	1735	—	1763	194	263
4	158	121	72	142	118	50	31	32	120	91	94	1720	890	1813	200	280
4	158	128	70	139	118	49	33	31	125	82	84	1710	905	1838	197	268
6	154	118	65	142	107	45	34	31	131	92	92	1747	947	1800	193	265
0	154	121	67	140	108	47	29	33	130	90	94	1707	914	1820	191	250
2	158	125	74	144	114	49	32	33	125	96	96	1735	920	1840	190	252
4	154	127	69	150	118	55	31	31	123	97	97	1708	895	1880	195	276
1	160	127	72	140	110	53	33	33	128	93	93	1740	918	1850	201	283
6	158	124	71	146	108	50	32	34	127	96	98	1713	917	1763	181	270
6	152	122	68	136	106	49	30	30	130	97	95	1690	902	1751	188	237
4	166	117	68	144	122	52	33	33	133	89	88	1770	943	1846	206	273
9	166	120	76	142	108	51	34	32	125	92	93	1708	923	1793	193	267
0	156	121	70	132	104	53	30	34	127	97	90	1725	913	1770	190	250

...me from "the North."

[1] Mother's name Kane, = in Irish, O'Keon, not O'Cahan.

3. *Vital Statistics (General and Economic)*:—

(A.) *Population.*—The population of Ballycroy has fluctuated a good deal within the last sixty years, but on the whole has not diminished as much as that of more thickly peopled parts of the country. The Table given below shows the population of the district at each census since 1871; also the number of houses inhabited, average number of inhabitants per house, and number of acres per head of the population at each of these periods:—

Census.	Population.	Houses.	Inhabitants per house.	Acres per head.
1871	2041	346	5·89	25·38
1881	1991	324	6·17	26·06
1891	2036	344	5·92	25·53

This Table shows the great sparsity of the population, about 25 per square mile. Ballycroy is thus probably the most thinly peopled district of its size in Ireland.

The region is subdivided into two districts, North and South Ballycroy, the latter of which is the larger, and the more thinly populated. The distribution of population, inhabited houses, and outbuildings between these two districts in 1891, was as given below:

Locality.	Area.	Population.			Houses.	Outbuildings and Farm-steadings.
	A. R. P.	Persons.	Males.	Females.		
N. Ballycroy, .	20,510 0 10	1191	588	603	197	163
S. Ballycroy, .	31,372 2 18	845	424	421	147	198
Totals, . . .	51,882 2 28	2036	1012	1024	344	361

From this it will be seen that the females slightly exceed the males in number.

In Knight's "Erris" the following are given as results of a census in 1831 (p. 99):—

Houses inhabited,	424
Number of families,	505
Number of persons, male and female,	2925
Number of males,	1420
Number of females,	1505
Number of males over 20,	473
Employed as handicrafts (*sic*),	59
Employed in agriculture, &c.,	817
Farmers of first class,	16
Farmers of second class,	489

(B.) *Acreage and Rental.*—The total area of the district is 51,882 acres, and the valuation £1937.

The holdings are small, averaging about 4½ acres under tillage: the whole would average some 15 acres, with a rental of about £5 for the better class, about £3 for the poorer. The tillage land is in many cases held in strips, often by two or more men in partnership. There is but little commonage, as most of the "mountain" or moor-land is in the landlord's hands, and let out for grazing. In 1891 there were 76 holdings of between £4 and £10 valuation, 289 of £2 and under £4, and 96 of under £2.

Formerly in Ballycroy, as in the rest of Erris, the land was held by communities, under a head man or king, who parcelled out the collops, or holdings, by lot every third year, as described by Mr. Knight, and quoted in last year's Report. This system has ceased to exist for many years, and the holdings are now mostly held at judicial rents.

(C.) *Language and Education—Language.*—The people may be said to be practically bilingual, as most of them speak both Irish and English. A number of older people speak Irish only, but they are rapidly becoming fewer. The dialect they speak is somewhat different from that of the other peoples of Erris, though not so much so as formerly, and has most of the characters of Ulster Irish. The exact proportion of those speaking Irish only, and Irish and English, was not ascertainable, as the census only gives language returns by baronies. In 1891 the barony of Erris, with a population of 16,504, had 726 who spoke Irish only, 5394 Irish and English.

Education.—There is a very considerable proportion of illiteracy in the district; but here again I am unable to give the exact amount, as the returns on this subject are made by parishes, and Ballycroy

forms only a part of the parish of Kilcommon, as all Erris outside of the Mullet is designated. In 1891 the condition as regards education of this very large parish was as given in the Table :—

	Persons.	Male.	Female.
Number above 5 years,	10,988	5310	5688
Illiterate, . . .	5382	2266	3116
Percentage, . .	48·9	42·7	54·8

The chief reason for the high rate of illiteracy prevailing in Ballycroy seems to be the scattered nature of the population, and the long distances of many of the houses from any of the schools, of which there are three in the district.

(D.) *Health.*—The following notes regarding the health of the people were obtained, for most of which I have to return my best thanks to Dr. P. M'Hale, of Ballycroy, who kindly afforded me the opportunity of seeing many of the cases personally, and also allowed me access to notes of cases. On the whole, the population is a healthy one, and there is but little serious disease, though there are many trivial ailments, for the most part attributable to the nature of their food and dwellings, and of their occupations.

Consanguineous Marriages.—Marriages between relatives are of pretty common occurence in this district, for several reasons; one of these is the strong clannish feeling of the people, another the nature of their relations with the inhabitants of the surrounding districts; and, lastly, the difficulties of communication which prevent much movement of the population. These unions are not commonly of nearer degree than second cousins, which seems to be the most usual relationship in these cases. In addition to these there are many, if not the majority, of the marriages in which the parties are related more or less distantly to one another, often in no very distinguishable degree.

The kindness of the Rev. Henry Hewson, P.P., of Belmullet, who supplied me with the list of marriages and of dispensations for marriage on account of relationship from the year 1875, extracted from the record of dispensations for the diocese which he has kept since that year, enables me to give actual figures. In the Roman Catholic parish of Ballycroy,[1] which contains about 320 families, there

[1] It is not a parish in the Census Returns, but forms part of Kilcommon, Erris.

were in that period 147 marriages altogether, and of these 50, or 34 per cent., were consanguineous.[1] This long-continued intermarriage does not appear to have produced any of the degenerative effects ascribed to it by M. Devay and others. As before stated, the people are well grown and healthy as a rule, and the proportion of serious disease, especially congenital, is but small. The people themselves do not appear to attribute any evil effects to this purity of strain. Its only effect seems to be, as noted in other districts, the strong personal resemblance among many of the people of the district which must at once be noticeable to a stranger arriving among them.

Diseases.—The following, as far as could be ascertained, is the state of the population as regards disease. Figures are given where-ever they can be accurately known. The principal diseases may be classed as follows :—

Insanity is said to be very rare in the district, but the actual number of cases could not be obtained.

Idiocy and Imbecility.—There are no idiots properly so-called, but there are two, or at most three,[2] individuals who are said to be " weak minded," though shrewd enough in most things where their own interest is concerned.

Epilepsy.—Several cases are known to exist, but as these do not usually seek professional aid, the actual number is not ascertainable.

Deaf-mutism and Deafness.—There is one deaf mute (a female): parents so far as could be learned not relatives. There are also two cases of deafness consequent on acute diseases.

Blindness.—There is no congenital blindness, but several old people are blind either from cataract or as the result of injuries.

Malformations.—Congenital malformations are very rare. There is a case of hare-lip in one family, parents not relatives.

Herniæ.—Three cases have been noted within recent years.

Albinism.—There are four albinoes in one family; the father is dark-haired, the mother red-haired, they are not in any way related so far as they know.

Fevers.—No information obtained.

" *Constitutional* " *Diseases.*—Phthisis and struma are not at all uncommon. It is also noticeable that many of the young girls are

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[1] The total number of marriages for the whole barony of Erris in the same time was 1210, and of these 265 were between relatives of a degree requiring dispensations, a percentage of 21·9.

[2] Here my informants differ.

anæmic in spite of the open-air life they lead (*query*, is this due to the almost exclusively vegetable dietary ?).

No information was obtainable respecting malignant disease. The cases probably fall into the hands of "wise" men or women, or into those of cancer-curers such as practise in the Mullet district.

Rheumatism seems to be very common, especially in the old.

Tonsillitis, too, is not unfrequently seen.

Hysteria is by no means unknown.

Dietetic diseases.—Owing to the nature of the food, dyspepsia is very prevalent, and the increasing use or abuse of very strong tea at all meals seems to deserve a large part of the blame which is ascribed to it by some of the older people.

Ento-parasites are said to be of common occurrence.

Respiratory diseases.—Bronchitis is very common in the winter and spring months, especially among the older people.

Local affections are, as was noted in the Mullet, few, and usually of but little importance. Several cases of ophthalmia, and some of senile cataract, also one of "Jacob's" ulcer have been noted of late.

The teeth are usually short, broad, even, and white; but dental troubles are by no means uncommon.

Female troubles seem to be very prevalent. The one most often noted was menorrhagia.

Venereal diseases.—As is the case commonly in Irish rural districts, venereal complaints may be said to be practically non-existent.

Skin.—A number of skin diseases come for treatment, the principal of which are eczema, impetigo, scabies, and tinea tonsurans.

Accidental injuries are of frequent occurrence, amongst the most common of which are cuts and contused wounds, fractures, and burns.

(E.) *Longevity.*—Though there are no centenarians now in Ballycroy, yet there are two persons living who are over ninety years of age, still hale and hearty, and a good many cases of people over eighty years of age.

4. *Psychology.*—A sketch of the mental character of the people, as well as the physical, is necessary to the completeness of a report such as this, and accordingly inquiries were made on this point of people of all classes and conditions who have daily dealings with them, as well as such observations as could be made personally during a stay among them of limited duration, and the result is, on the whole, very creditable to the community at large. As is the case with most such communities as this, isolated by reason of origin and customs, the people of the other parts of the barony seem to look upon the inhabi-

tants of Ballycroy with a good deal of distrust, and many tales are told to their disfavour, for which the usual allowance must be made. Trustworthy informants, however, seem to agree in the statements following:—The people of Ballycroy are reputedly sharp and shrewd in matters of business; they are good judges of character in their customers, and can readily adapt themselves to their peculiarities, and, their neighbours assert, are not over-scrupulous about taking any advantage which offers. As a rule, however, creditable informants state they are very honest in their dealings with one another.

They are fond of amusement, especially music and dancing, and show more signs of artistic taste than were observed in any district yet reported on, though their choice in colours may not be always classically correct. They are sharp at repartee, and a good deal given to joking, often of a very practical nature. Formerly this district was noted, like the other parts of Erris, for the litigious character of its people, but this spirit has largely died out. The faction fights which used to occur between the peoples of North and South Ballycroy are a thing of the past, though some few remaining signs of the old feeling on this point were noticed. The Ballycroy people used formerly to be noted for their quarrelsome nature, which is almost proverbial in the other parts of Erris; but this no longer characterises them to the same extent, a change which is said to be in part at least due to the almost complete suppression of illicit distillation in the district. When quarrels occur the men seldom go the length of a stand-up fight, man to man, but make use of abusive language, and throw stones, or several will set on one. They are not, as a rule, given to drink, and in their everyday life are sober and quiet, but on fair days, or at races or other public occasions, a good deal of drinking takes place. When in liquor they are very boastful, and the local pride, which is evident in them at all times, shows out more strongly. Most of them seem to look upon themselves as far superior to all the neighbouring peoples. This pride, by cultivating a sense of self-respect, seems, in some cases, to be the moving spring of a manly and independent spirit which is exhibited by many. In connection with this, one curious feeling may be noted. It was some years ago considered to be an indelible disgrace to any Ballycroy woman to sell butter.

To strangers the people are obliging and kindly, ready to afford information, and extremely hospitable. To one another they are generous, especially in times of trouble or adversity, when, even though in straitened circumstances themselves, they are ready to help those worse off.

The moral character of the people is very good, as illegitimacy, though not unknown, is of very rare occurrence. There is practically no crime in the district, and it is a long time since any serious offence was committed there. They are said to be devout in their religious observance.

This section may be concluded by quoting the accounts given of the people by writers on the district. Mr. Knight's description,[1] written sixty years ago, is practically accurate as applied to the people at the present day. He says that they are "bold, daring, and intrepid in danger; not good-tempered, but hospitable to an extreme. A stranger seldom enters their country without having the usual salute of 'you are welcome to the country, stranger,' given him, be he known or not. They are considered generally very intelligent, and having that degree of cleverness and acuteness, particularly in bargaining, said to be peculiar to their northern origin. They are the material of a fine people, if properly managed."

With this account, that given by the novelist Maxwell (long a resident in the district) closely tallies. Writing a little earlier in the century he says[2]:—

"The inhabitants of this district are extremely hospitable to passing travellers, but by no means fond of encouraging strangers to sojourn permanently among them. This latter inherent prejudice may arise from *clannish* feelings, or ancient recollections of how much their ancestors were spoliated by former settlers, who, by artifice and the strong hand, managed to possess the better portions of the country. They are also absurdly curious, and will press their questions with American pertinacity, until, if possible, the name, rank, and occasion of his visit, is fully and faithfully detailed by the persecuted traveller.

"On the score of propriety of conduct, I would assign the female peasantry of this district a high place. When the habits of the country are considered, one would be inclined to suspect that excessive drinking, and the frequent scenes of nocturnal festivities which wakes and dances present, would naturally lead to much immorality. This, however, is not the case: broken vows will, no doubt, occasionally require the interference of the magistrate or the priest; but generally the lover makes the only reparation in his power, and deceived females or deserted children are seldom seen in Erris."

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[1] Erris, p. 106.

[2] "Wild Sports of the West," Chap. XLVII.

5. *Folk-names.*—The following list of the surnames of the district was obtained. It contains all the surnames now in Ballycroy, with the exception of a few families recently settled in the region:—

Surname.	Number of Families.	Surname.	Number of Families.
Bradley, ...	2	Kane, or Keane, ..	16
Bradshaw, ...	3	Kilroy, ...	2
Cafferky, ...	25	Little,[1]	1
Cadden, ...	1	Lenahan, ...	20
Calvey, ...	8	Loftus, ...	1
Campbell, ...	7	M'Ginty, or Ginty,	14
Carey, ...	1	M'Gowan, ...	5
Cleary, ...	1	M'Guire, ...	4
Cooney, ...	2	M'Greal, ...	1
Conway, ...	31	M'Hugh, ...	2
Cormack, ...	3	M'Manamon, ..	16
Corrigan, ...	15	M'Neely, ...	6
Deane, ...	2	M'Tighe, ...	3
Dooher, ...	4	Malley, ...	2
Doran, ...	6	Masterson, ...	1
Dyra,[1]	1	Molloy, ...	3
Fallon, ...	1	Monaghan, ...	1
Finn, ...	2	Moran, ...	3
Gallagher, ...	5	Murray, ...	9
Gaughan, ...	2	O'Donnell, ...	8
Grealis,[2]	1	O'Hora, ...	1
Gruddy, ...	1	O'Boyle, ...	5
Henry, ...	2	Sweeny, ...	25
		Togher, ...	4

Some of the less numerous of these surnames are comparatively recent importations from the surrounding districts. Some names once common in the district have now died out. One of these was Lynott, one of the old Anglo-Norman names.

The families whose ancestors came "from the North" take great pride out of it, and rather look down upon those who are the descendants of the aboriginal inhabitants.

IV.—SOCIOLOGY.

1. *Occupations.*—Though the district is maritime, the population is almost a purely pastoral one, sea-fishing not being practised as a mode of livelihood by any considerable portion of the people. The majority of the farms are of very small size, averaging about 4 to 4½ acres for the poorer class, 15 acres for the better off, under tillage,

[1] Not native. [2] From Inisbiggle.

but usually having a large mountain run, over which the tenant has grazing rights. The average rent for a holding of the better class would be about £5, £3 for the poorer. As in the Mullet, the land is not usually well fenced. The principal crops are potatoes, barley, and rye. Spade labour is almost universal. Sea-weed is the principal manure. A plot of land is cropped until worn out; then a fresh piece is reclaimed and fenced, and so on. During the summer months the cattle were formerly moved to the mountain runs; some of the younger people going off to tend them there, and living, while thus engaged, in roughly-built huts called boothies. This custom was still in vogue until about thirty years ago.

Many of the men—my informants stated the number at about 130—annually go to England or Scotland every summer to work as migratory labourers, returning to their homes for the winter months.

Along the coast-line a good deal of kelp is made, on which no royalty is paid. The sea-weed for this purpose is sometimes brought by boat to points where it is to be burned, but Knight mentions a method of conveying it common in his time, and still practised. A description of it is best given in his own words: "Transporting sea-weed from one part of these sheltered shores to another, either for burning into kelp or for manure, in large masses, without any other means than a man standing on the heap, and pushing it forward with a long pole, is a very common practice, and hundreds of these may be seen floating with the tide up and down the sound of Achill, or on the Ballycroy shores, in the fine summer days; while a single man sits quietly on the heap, roasting his potatoes and limpets, or other shell-fish, for his evening meal, carried forward towards his destination without any trouble or exertion from him until the tide slackens, or that he is obliged to pole it forwards in some parts against the current."[1]

As before stated, there is practically no sea-fishing; a few coal-fish

[1] I am indebted to my friend Mr. G. H. Kinahan for the following note on the cutting and transportation of sea-weed:—"During springs the weed-cutters must be on the claddagh (the foreshore left dry during low water) when the tide is one-third gone; the men with hooks cut the weed, while the boys and girls pile it in heaps like hay-cocks; these heaps must be properly built to give them solidity. As the tide comes in, the men come back and put a *suggaun*, made of sea-weed, round the butt of each heap, or two *suggauns*, one above the other, if there is a rough sea. If the sea is rough, they often fasten a rope to the heap, and tow it into shelter as the tide rises. If there is a quiet sea, a man will sit on the heap, and, as it rises, will direct it with a pole to wherever he wants it to go; he will even go out into he tidal race, and run with it to the place he wants to land the weeds, generally ome harbour or coose where it can be easily landed, and carried to the land."

are taken occasionally; periwinkles are gathered in large quantities on the sea-shore, and large lobsters are sometimes found among the crevices in the rocks. About forty men are employed netting salmon in the chief river of the district. There is not much regular employment for labourers, for whom the average rate of pay is about 9*s*. a-week. Tradesmen are few; there are four hand-loom weavers, and two blacksmiths. During the winter months there is little work of any sort done.

Like the Mullet district, Ballycroy exports very large quantities of eggs, most of which are sent to Westport and thence to the English market. Eggs are said to be occasionally used for barter. The women, besides the ordinary domestic duties, carding, spinning, &c., take part in all field labour with the men, and gather sea-weed for manure; the only kind of outdoor work they do not engage in is cutting turf, which is the main fuel of the district. Some of the turf is exported to Inishkea and the lower extremity of the Mullet.

2. *Family Life and Customs.*—The family life of the people of Ballycroy is on the whole very similar to that of the people of the other parts of Erris and of the natives of Inishbofin, and so need not be described at any length, the reader being referred for details to the previous report.

The children of a family are sent to school young, if at all, but their attendance is stated to be rather irregular, owing to the long distances the children have to go and the wild nature of the country. They leave school young, and then enter into the ordinary work of the family.

The people do not as a rule marry as early as those of some other parts of the country, many girls not getting married until 25 years of age. Business and family interests have usually more to do with the matches than romantic attachment, the matter being arranged as a rule by the parents beforehand. After all has been settled, the young man goes, taking with him a spokesman to explain his errand, and a bottle or two of whiskey, and the girl's consent is asked; if this be given, the parents then arrange about the dowry, and at this stage the match may be broken off if satisfactory terms be not arrived at. A calf or a pig may be the cause of upsetting the arrangement. Weddings are occasions of great feasting and merriment, and usually are concluded by a dance. Straw boys (*clommeraghs*) go round to these dances as described in the report on the Mullet. It is not considered etiquette in Ballycroy that these strawboys should take any drink at a wedding. The taking of the bride to her husband's house

is another occasion of festivity, though not now of so uproarious a nature as it was in the earlier part of this century, when it was thus described by a writer who was long resident in the district:—
"'Dragging home' is the bringing the bride to her husband's house. An immense mob of relatives and *clevines* of 'both the houses' are collected on the occasion, and as an awful quantity of whiskey must of necessity be distributed to the company, this high solemnity seldom concludes without subjecting the host's person and property to demolition."

The ceremonies and observances relating to deaths are very fully kept up. Wakes are still held, but only in the case of old people, the young not being waked. Most of the old games and observances are still kept up, but it is very difficult to obtain information respecting them. The corpse is lifted on to the bier at the house, and off it at the graveyard, by the relatives on the male side of the family at one side, and by those of the female side at the other. It is considered unlucky for the party whose side of the bier touches the ground first. The coffin is always taken to the graveyard by the longest route. On reaching the cemetery the coffin is carried to the place where it is to be interred, and then the people all scatter to kneel and pray at the graves of their own relatives. After this, new pipes and tobacco are served out to those present, who sit down and smoke.[1] After the pipes have been smoked, the weeds are cleared away and the grave is dug. It may be worthy of remark here that a grave is not dug on a Monday if possible, and if for any reason a burial has to be made on that day, a sod is raised the day before. After the grave has been dug and the coffin lowered into it, a band of women gather round it and sing the *caoine*, which here has not degenerated into mere discordant wailing, as it has in some other places, but is often really very musical and plaintive. When this has been done, the mourners are sprinkled with holy water and then engage in prayer; after which the grave is filled in, covered over with rough stones, often white in colour, and the unused pipes placed upon it. Until the prayer is over, it is considered both bad taste and extremely unlucky to leave the graveyard. To stumble in a cemetery is believed to indicate that the person who does so will die within the month.

Unbaptised or still-born infants are buried at night in separate burying grounds, by themselves. One of these infant cemeteries is at Bunmore.

[1] In some cases it is said that a small turf fire is lighted at which the smokers light their pipes, but I have not seen this personally in this district.

One social function, going for the sand-eels, ought not to pass without mention; it is the cause of considerable gatherings of the young people on the sea-shore on moonlight nights, the object being as much the amusement as the sand-eels themselves. The mode of taking these latter is by passing a blunted reaping-hook or a knife through the sand.

3. *Food.*—The dietary of the bulk of the people is almost exclusively vegetarian. As a rule it consists of potatoes, boxty (or potato-bread), flour-bread, and, to some extent, eggs and milk. A great deal of imported meal and flour is consumed, and tea is now used at nearly every meal, which, as it is made very strong, and drunk in large quantities, is probably responsible for a very large part of the digestive trouble so common among the people. A good deal of Indian-meal stirabout is taken during the summer months.

Fish, when used, is obtained from Newport or Achill.

The people usually take three meals in the day.

4. *Clothing.*—The population, as a whole, seems to be well and comfortably clad on public occasions, though many of the poorer people are rather ragged in working attire. The clothing is very largely imported, and quite modern in style; but a good deal of greyish-coloured and other home-spun is still worn, some of which is of a very high class. The dress worn by the women on working days is still of the old style, a short petticoat of a very bright red, dyed with madder or an aniline dye, a dark bodice, and a small tartan shawl over the shoulders, and a red handkerchief tied under the chin covers the hair. The old-fashioned heavy cloak of dark blue cloth is worn when at work away from home. Of late it has become a common practice among some of the better-to-do farmers to send the wool of their own sheep to the woollen mills at Foxford or to Scotland to be made up for them. A good deal of home-made flannel is worn in shirts, and the blankets too are of local manufacture. The wool for the homespuns is oiled, corded, and spun by the women, and then sent to one of the weavers. The regular charge made by these weavers is threepence a yard for frieze or flannel, fourpence per yard for blanketing.

Some of the old dyes are still made use of. A yellow is obtained, as in Bofin, from a lichen (*Ramalina scopulorum* ?) which they gather from the rocks; a greenish colour is got from the tops of the heather, also a black from some other plant, no specimen of which could be obtained.

morning, and people have been known to desist from the projected undertaking on this account. It is also unlucky to have a hare cross one's path, but not so much so as the meeting of a red-headed person.

Ill fortune also follows the digging of a grave on a Monday, the change of residence on that day, the removal of one of the pipes off a grave, giving fire out of the house on May Day, and the molesting of the wild swans which visit the coast in winter. To stumble or fall in a graveyard is looked upon as a sign that the person so doing will die within the month. The death-warnings mentioned in the report on the Mullet are also believed in here, as is the evil eye; the consequences of which may be averted in the manner mentioned therein (*l. c.* 631). It is considered by some to be very unlucky to rescue a drowning man, as he will be certain to do some evil to his rescuer. The old belief that blood will start from the body of a murdered person at the touch of the murderer, is still prevalent. Fairies are believed in by many, and many tales of their actions are related. They are believed to be a class of fallen angels who took part with Satan to some extent, but whose guilt was not sufficient to condemn them to the infernal regions, and were, instead, made to wander through the universe. Michael Conway, who has a local reputation for his knowledge of their ways, says that they are of three classes—the first were made dwellers in the air; the second, in the sea; and the third, on the earth. They are accused of doing much mischief, both to men and to domestic animals. Cattle becoming suddenly ill are said to be "shot" by them, and the "cure" applied by a wise man who possesses a fairy stone (arrowhead) is the passing of the said flint arrowhead over the back and under the belly of the animal thrice, accompanying the action by suitable incantations.

Changelings are believed in, and tales are told of cases of this nature. Quite recently the fairies were supposed to have stolen away a child, and carried him to a distance of three miles. Michael Conway states that he knew a man who, when out one night, heard sweet music of pipes, and in an ecstasy he danced to the music; he died within the year.

The people do not meddle with an old rath or fort, even though in the centre of cultivated land, as they believe these to be favourite dwelling-places for the fairies. A man built an addition to his house upon a "fairy hill": he died within the year (was drowned), and later on his brother also died. A hearth should always be swept clean, and new fire put down when going to bed for the fairies to warm themselves at.

The devil, as usual, bulks largely in the local tales; he is said to

have appeared to one woman in chapel! Satan explained to her that he went to the church because people were so thoughtless there, and the women went there mostly to criticise each other's clothes. Demoniacal possession is believed in, and a tale is told of a possessed man near Mount Jubilee, between Belmullet and Ballycroy.

Considering the wild nature of the country, it is not wonderful that ghosts should be met with, and phantoms of various kinds. The people used to dread passing a spot on the main road after dark, as the ghosts of people slain in faction fights there (it being on the boundary between north and south Ballycroy) were believed to appear there, and to haunt especially the families of the slayers. The ghost of a sportsman, who many years ago met his death on the mountains, is said to be sometimes seen.

On the road between Ballycroy and Bangor, Erris, a phantom dog sometimes appears, as does a white cow, whose appearance is looked on as a death-warning. Several of the lakes are thought to be inhabited by "water horses," which sometimes come on land and endeavour to coax unwary people to mount them, and then, having got them mounted, carry them off into the water. They are believed to be seen once in every seven years.

Among the customs observed may be mentioned wakes, at which all the old games are kept up. These wakes are now only held on old people, not on younger ones.

The funeral observances have been described in another section. A straw cross is placed in the roof of some of the houses on All Hallows' Eve to avert evil. Fires are lighted on St. John's Eve (June 24), as described in last year's report.

At one time the most inviolable oath taken in this district was that sworn with the hand on a skull; this is still believed in, but never practised now.

Straw boys (clommeraghs) go round to weddings, and dance with the bride as in the Mullet.

Practically no information could be obtained as to the leechcraft, or folk-medicine, of the district. Several "wise" men and women practise in it, but they keep their remedies secret as far as possible. Head-measuring, the application of various unguents and charms for the rose (erysipelas), and the use of charms for toothache, as described in the other part of the barony, were all that any information could be obtained about. Many local herb remedies are said to be in use, but beyond this vague statement no further information could be got. The only treatments of interest in the diseases of cattle,

of which any description could be got, were the treatment of fairy-"shot" animals described above, and the tying of the "worm-knot" with the object of destroying entoparasites.

2. *Legends and Traditions.*—As has been already stated, there are a good many local traditions, mostly of a minor character; but, owing to the reticence of the people on this subject, only a few could be obtained, the chief of which have been recorded by Mr. Maxwell. The "Legend of Knock-a-Thample" is still told practically as given in his well-known work, "The Wild Sports of the West," and the grave of the "Red Pedlar" pointed out. Tales are told of a daring robber who, in past times, lived in a cave in the mountains, and who was at last hunted down and killed. Lough Curafin, in the mountains, is said by the country people to owe its origin to the massacre of a priest and his people (in the time of Cromwell, they say) on the spot where the lake now is; the ground sank down and the water covered it, thus forming the lough. The water is dark-coloured, and the people say that waves are on it even on the calmest days when there is no wind; they also say that the fish in it will never take a fly. Strange to say, though such a conspicuous character as Grace O'Malley held the Castle of Doona, and lived for some years there, local tradition is almost dumb about her; the story of a fight in the courtyard, where the O'Malleys captured the castle from the M'Mahons, seems to be almost the only trace of her memory which is preserved here; while a few miles off, in Achill, there are many legends about her. This is probably due to the ancestors of the present population supplanting the aborigines.

VI.—Archæology.

This district contains much that is interesting to the archæologist, but, as in former reports of this nature, all that can be done here is to indicate what is worthy of notice to those who make Irish antiquities their study.

1. *Survivals.*—Owing to the greater comfort of the people, these are fewer than in the northern part of the barony. Querns are no longer in use, though they were until quite recently; the type of wool-wheel, the sheep-skin sieve, panniers on the horses' backs, and the use of hooped piggins are the chief amongst the remaining articles not yet deposed by our modern appliances. The clothing has been before referred to. One article still in use is worthy of notice, the otter, an implement of very ancient origin in Ireland, is used sometimes for fishing in the fresh-water lakes.

2. *Antiquities.*—There are not many ancient buildings or monuments in Ballycroy, which must always have been a thinly-populated district, and of those that exist, all, or nearly all, are of far earlier date than the Ulster colony. The remains still in existence are in much the same condition as when O'Donovan noted them in 1838; the people generally respect these old monuments, and so the only destroyer in the meantime has been the weather.

The object of this section is to point out the objects worthy of note to archæologists, not to enter upon a description at length, which is left to more competent hands, and so only a short notice is given here. The most ancient remains seem to be a cromleach near Claggan, a "druidical circle" at Tallagh, and numerous small earthen forts scattered through the district. At a place called Kildun (*Cill-a-dhuin*), where a peninsula juts out into the bay, is an ancient burying-ground, and an upright monumental stone or slab inscribed with a cross within a circle. The other buildings and monuments are apparently of more modern date; they comprise churches, holy wells, two castles, and a monument. At Bunmore there is the ruin of *Tempull Enna* (St. Enda's Church), a small ancient building of which, as in O'Donovan's time, there is but little standing; not far from the church is *Tobar Enna* (St. Enda's Well),[1] which is covered by a beehive-shaped structure of stone, on the front of which is a slab rudely marked with a cross. The church and well are the scene of the "Legend of Knock-a-Thample," which has been already referred to in this paper. Not far from the well is what is pointed out as "the Red Pedlar's Grave," in which the murderer is said to be interred. At Claggan, in the south of the district, outside of the graveyard, is, or was, *Teach Fiontainne* (the house of St. Fintanny), the site of a small church. O'Donovan says that "St. Fintanny was the author of the Pagan History of Ireland, and is said by tradition to have lived longer than Methusalem (*sic*), and to have been contemporary with the very old woman called Cailleach Bheartha." Inside the graveyard is the Well of St. Fintanny, where stations are performed. Just outside this graveyard is a small rocking-stone.

At Castlehill (*Knock-a-chaislean*) there are the foundations of a castle torn down for building materials some time in the last century;

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[1] Some call this well St. Catherine's; it is believed by the people to possess anti-Malthusian properties; also, to be efficacious in curing eye troubles, abscesses, and dog-bites. Stations are performed here.

At Bunmore there is also a *killeen*, or ancient burial-place.

of the founder or possessors of this castle local tradition is altogether silent—no one knows who they were.

The best known of the ruins of this district is the Castle of Doona (*Dun atha*), of which many contradictory traditions are in existence. Some ascribe its origin to the famous Grace O'Malley, who is said to have spent some of her life there; others assert that she captured it from the MacMahons. O'Donovan, whose informant was a Mr. Cormic, whose family was of old standing in Erris, says that it was built by Brian Revagh O'Kelly, who was married to one of the Barrets, and flourished here in the reign of Elizabeth; another account again states that it was built in the time of *Domhnall Duall bwee*, a Damnonian chief who lived before the time of Christ. If there was ever a dun here it seems to have been entirely removed. The castle is built of rough rubble stones, and the walls are very thick; but the greater part of it is in a very ruinous condition. The main tower was split in two many years ago by the accidental firing of a turf stack in its interior; one half fell, the other is still standing. The court-yard and passage to the landing still remain. Part of the castle has been transformed into a modern farmhouse and offices.

Not far from the castle is Doona Church, a building about six centuries old; it is about 50 feet in length, by some 20 in breadth. It was somewhat modified in form about two centuries ago, when certain additions were made to it. The interior is used as a burial-place, and is choked up with graves which have raised the soil far above the original floor level.[1]

The most modern of all the monuments of Ballycroy is *Lachta Dahya Ban* (Fair David's Bed), a monument on the top of Corslieve Mountain, between Ballycroy and Tirawley. "Fair David" was a notorious robber chief who lived in a cave in the mountains, and was a scourge far and wide; he was hunted down and killed at this spot about two centuries ago.

VII.—History.

The earlier history of the district is the same as that of the rest of Erris, which has been given at length in the Report on the Mullet, Inishkea, and Portacloy, and so will only receive a brief notice here.

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[1] O'Donovan remarks that the skulls of the Kinnelconnell tribe, which he saw in Doona Church, were "higher in the forehead and broader than those of the Connacians."

Erris was anciently inhabited by the *Damhnanns*, or Damnonii, a Firbolg tribe, who held the territory for some centuries. They were conquered by Tuathal Teachtmar, a Milesian king, some time in the second century. The family of O'Caithniadh (O'Kane) now held sway until about the beginning of the 14th century, when the Anglo-Norman and Welsh families of Burke, Barret, Lynnot, and others obtained a foothold in Erris, and eventually became the rulers of it. In or about the middle of the 17th century the district was colonized by the ancestors of most of the principal families now in existence there. The exact date of this immigration does not seem to be clearly known, but, from some pedigrees collected by O'Donovan in 1838, the families he mentions would seem to have been in the district for six or seven generations. He notes that the people "have no other chronology but the number of generations since their emigration, a very primitive mode of calculating time." Counting a generation as thirty years, eight or nine must have now elapsed, giving the colony the probable age of 240 to 270 years. O'Donovan also states that "Ballycroy and Ballymonnelly (an adjacent district) were colonized by tribes from Tirconnell about two centuries ago"; "Ballycroy was colonized by several families from the same county, who settled under O'Donnell"; and adds, "the principal surnames among them are M'Sweeny, O'Clery, O'Gallagher, Conway, MacManamon, and O'Friel. These still speak the Ultonian dialect of the Irish, and are called by their neighbours *na hUltaigh*, *i.e.* the Ulstermen." The colonists are said, by tradition, to have come to the district by sea, and to have landed at Fahy, near Doona Castle.

In the Appendix to the "Genealogies, Tribes, and Customs of Hy Fiachrach," in the notes on the O'Clery family, the following mention is made of the movement of this family into Ballycroy from Donegal:—
"*Cucoigcriche, or Peregrine O'Clery, the eldest son of Lughaidh.*—He married one of the Mac Sweenys, of the county of Donegal, by whom he had two sons, Diarmaid and John. It appears from an inquisition taken at Lifford on the 25th of May, 1632, that he held the half quarter of the lands of Coobeg and Doughill, in the proportion of Monargane, in the barony of Boylagh and Bannagh, in the county of Donegal, from Hollantide, 1631, until May, 1632, for which he paid eight pounds sterling per annum to William Farrell, Esq., assignee to the Earl of Annandale; but, as the document states, being 'a meere Irishman, and not of English or British discent or sirname,' he was dispossessed, and the lands became forfeited to the king. Shortly after this period he removed, with many other families of Tirconnell,

to Ballycroy, in the south of the barony of Erris, in the county of Mayo, under the guidance of Rory or Roger O'Donnell, the son of Colonel Manus, who was slain at Benburb in 1646, and the ancestor of the present Sir Richard Annesley O'Donnell, of Newport."[1] This would place the settlement at about 1640, thus agreeing closely with the traditional number of generations since the families concerned came to Erris.

More modern history can scarcely be said to exist. Owing to the wildness and remoteness of the region, it became in the last century a resort for smugglers, of whom many tales are told which belong more to legend than to history.

In the first half of the present century, about 1840, the district was opened up by the construction of the first good road, and brought more into contact with the outer world; but it still remains greatly isolated and comparatively unknown.

VIII.—Concluding Remarks.

Little remains to be said in conclusion. As this paper, like its precursors, is a record of facts observed, collected as means of forming a basis of comparison between different parts of Ireland, theories and personal opinions are not ventured upon.

The tradition as to the origin of the greater part of the people of Ballycroy seems to be fully borne out by facts, but it seems probable that all the aboriginal families were not driven out by the colonists, and that some of them, remaining in the district, have become absorbed into the mass. It was stated by some of the people that the familes whose ancestors "came from the North" rather looked down upon some of their neighbours, whose people were there before them, as they do on the inhabitants of the surrounding districts. The physical differences between the Ballycroy people, and those of the rest of Erris, are more noticeable in the casts of features and darker nigrescence than in their physical proportions, though, as before mentioned, some of these are noteworthy.

IX.—Bibliography.

The literature referring to this region is very scanty, but the following make more or less mention of it:—

Anonymous.—"The Saxon in Ireland" (London, 1851).

Bald.—"Map of the County of Mayo" (1813).

[1] His family were hereditary historians to the O'Donnells.

Bennett.—"Six Weeks in Ireland" (1848).

The Four Masters (*cf.* O'Donovan).

Knight, Patrick, C.E.—"Erris in the Irish Highlands and the Atlantic Railway" (Dublin, 1836).

Mac Firbis, Duald (*cf.* O'Donovan).

Maxwell, W. H.:

"Wild Sports of the West" (1829).

"The Dark Lady of Doona."

O'Donovan, John:

"MSS. Letters to the Ordnance Survey of Ireland" (1838). In the Library of the Royal Irish Academy.

"The Annals of the Kingdom of Ireland," by the Four Masters. Translated and Annotated by John O'Donovan, LL.D.

"The Genealogies, Tribes, and Customs, of Hy Fiachrach, commonly called O'Dowda's Country. From the Book of Lecan in the Royal Irish Academy, and from the Genealogical MSS. of Duald Mac Firbis, in the Library of Lord Roden" (Dublin, 1844).

Official:

"Census of Ireland, 1891," vol. iv., No. 3.

"Memoirs of the Geological Survey of Ireland."

DESCRIPTION OF PLATES III. AND IV.

Plates III. and IV. are from original photographs of the people taken during this visit.

VII.

ADDITIONS TO THE HEPATICÆ OF THE HILL OF HOWTH, WITH A TABLE SHOWING THE GEOGRAPHICAL DISTRIBUTION OF ALL THE SPECIES KNOWN TO GROW THERE. By DAVID McARDLE.

[COMMUNICATED BY F. W. MOORE.]

[Read April 13th, 1896.]

In the summer of 1893, shortly after writing a provisional list of the "Hepaticæ of the Hill of Howth," which the Royal Irish Academy did me the honour to publish,[1] I was engaged in making further research on the hill; and I was fortunate in gathering a liverwort, which was new to me, growing in some quantity amongst the limestone rocks near Ballykill. I had very little difficulty in determining its correct name to be *Jungermania attenuata.* It belongs to the *barbata* group, and was figured by Sir William Hooker in his fine work on the British Hepaticæ, under the name of *Jungermania barbata, β minor.* A specimen collected by Mr. E. M. Holmes at Abbey Wood, Kent, which is included in Carrington and Pearson's excellent Fasciculus (No. 74), quite settled the identification.

This was apparently the first discovery of *Jungermania attenuata* in Ireland. It grows most luxuriantly in company, and mixed with a pretty moss *Tetraphis pellucida*, which also seems hitherto to have escaped notice in the county Dublin district. Professor Lindberg, in his "Musci Scandinavica," calls the former *Jungermania gracilis*, Schleich; and Mr. M. B. Slater, F.L.S., to whom I sent specimens of the Howth plant, says:—"It is a pity the name *attenuata* has priority, as *gracilis* is more expressive of its habit of growth."

This interesting find was encouraging, and Mr. Moore wrote to Captain Rochford (Lord Howth's agent) for permission to collect in the demesne, which was kindly granted for the first four months of last

[1] Proceedings, 3rd Ser., vol. III., p. 108.

year, during which time I paid it several visits with good results, and the list would not be so extensive if this request had not been granted.

Such species as the rare *Jungermania minuta*, *Scapania æquiloba*, and *Lejeunea flava var.*, grow in great luxuriance. The last, in company with the commoner species *Lejeunea serpyllifolia*, clothes the large stones, and the stems of trees which margin a small stream. The pretty *Lepidozia reptans* and *L. cupressina* grow in large cushion-like patches, and such exuberant growth I have only found at Killarney. The centre of the demesne is sheltered on all sides, ancient lianas of honeysuckle hang from tree to tree, and on these and the fallen and decaying logs, with the damp genial atmosphere, liverworts and mosses grow in profusion. I do not know a prettier sight than the banks of *Pellia epiphylla*, and *Lophocolea bidentata*, yards in extent, with their white pellucid fruit stalks glistening with dew-drops, rising from the green velvet carpet of fronds, which I enjoyed in the wood one April day. The outer portion is backed up with stately conifers and rare shrubs, which quite surround the historic castle. The termination of the demesne at the hill is a natural rockwork, planted with choice rhododendrons, which grow luxuriantly, some of them attaining large dimensions, and, when bearing their trusses of bloom, are a sight well worth going there to see.

To my former list I have added nineteen species. One of these is new to the Irish Flora, and fourteen are additions to the Co. Dublin list of Hepaticæ; also seven varieties of more or less botanical interest. The total number of species now known to grow on the Hill of Howth is fifty-five. The appended Table, which shows their geographical distribution, will, I trust, be interesting, and I have endeavoured to make it as complete as possible, so far as the material for doing so at my disposal would allow. A glance over it will show that some of the Howth plants are local in Ireland. At the present time Howth is the only locality recorded in Ireland for *Cephalozia Francisci*, and *Jungermania attenuata*. *Plagiochila asplenioides* is rarely found in fruiting condition, so I have given a description of the male plant, which does not seem to be well known. The range of most of the species in Scandinavia and the Pyrenees is very striking, and it is interesting to note that the Hill of Howth plants extend mostly over the northern continent of Europe to North America, and from Pikes Peak, across the Rocky Mountains, to Cape Horn, Australia, New Zealand, Cape of Good Hope, West Indies, and Java. Four are found on the Island of Teneriffe, others in the Azores and Canary Islands. All the species, excepting three, are also found in Yorkshire

at various elevations. The West Riding has moorland hills up to 2000 feet. East Riding has wold chalk hills to 850 feet (cultivated). The North has moorland hills up to 2500 feet. For this information, and many other valuable hints as to the identification of critical species, I offer my best thanks to the well-known Yorkshire botanist, Mr. M. B. Slater, F.L.S., of Malton; also to Lord Howth, for granting through his agent, William Rochfort, Esq., J.P., of Cahir, permission to collect in the demesne.

The asterisk (*) before a name denotes that the species, or variety, is new to the Co. Dublin.

* *Frullania dilatata*, Linn. (Dum.). Proliferous form, bearing leafy shoots on the stems, and leaf margins, which reproduce the plant. *Hab.*—On rocks by the side of a stream near the Baily Lighthouse, February, 1894.

1. *Lejeunea serpyllifolia* (Mich. Dicks.). Libert. Carrington and Pearsons, Exic., Nos. 135, 195. By the side of a small stream in the demesne, on stones, and on decaying wood, plentiful. April, 1895.

2. **Lejeunea flava*, Swartz *var.* On stones and on the trunks of trees in the demesne. April, 1895.

Sub-sps. **Lejeunea Moorei* = *L. Moorei*, *Lindberg*, Act. Soc. Sci. Fenn. x., p. 487. Dr. D. Moore on "Irish Hepaticæ,"[1] p. 615, with excellent figure on plate 44.

3. *Lepidozia cupressina*, Sw. (Dum.). *Jungermania reptans*, *β. pinnata*, Hook. Brit. Jung., t. 75. *L. tumidula*, Taylor. On peat amongst rocks, Ballykill, April, 1894; in the demesne, on damp peat, March, 1895.

**Cephalozia catenulata*, Huben., *var. pallida.* Spruce. Amongst *Tetraphis pellucida*, Ballykill, bearing perianths, February, 1894.

**Cephalozia divaricata*, Smith (Dumort), *var. starkii* (= *J. starkii*). Funck. Nees. Hep. Eur. II. Syn. Hep. 134. On a damp bank near the Baily Lighthouse, April, 1893.

4. *Lophocolea heterophylla*, Schrad. Journal Bot. i. p. 66. Hook. Brit. Jung., t. 31. On decayed wood, Ballykill, April, 1893; Howth demesne, April, 1895.

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[1] R.I.A. Proc., Ser. II., vol. ii., Science, p. 590.

5. *Chiloscyphus polyanthus*, Corda. Hook. Brit. Jung., t. 62. By the side of a stream in the demesne, April, 1895.

6. *Saccogyna viticulosa*, Mich. (Dumort). Hook. Brit. Jung., t. 60. On a damp bank, Howth demesne, March, 1895.

7. **Scapania æquiloba*, Dumort. Carrington's Brit. Jung., p. 81, n. 3, pl. 8. fig. 26, *ex parte*, 1875. In the crevices of the rocks, Ballykill (very fine), 1894–5; plentiful in the demesne, April, 1895.

8. **Scapania aspera*, Müll. Pearson, in Journal of Botany, December, 1892, tab. 327. On rocks amongst moss in the demesne, April, 1895.

9. *Scapania resupinata*, Dumort. E. Bot. t. 2437. Amongst rocks in the demesne, April, 1895.

Scapania resupinata, Dumort, *var. recurvifolia*, Hook. Brit. Jung., t. 21, fig. 8. On a peaty soil amongst the heather, Ballykill, 1894, in the demesne, April, 1895.

10. *Plagiochila asplenioides*, Linn. (Dumort). Hook. Brit. Jung., t. 13. On a damp bank, and on stones in the demesne, bearing perianths, which contained unfertilised archegonia. Male plant smaller, with a stout stem one inch or more in length, of a brown colour, arcuate, flagelliferous at the base, with copious root-hairs, apex suddenly incurved. Leaves distant below, small, obovate or cuneate at apex, increasing in size upwards, more crowded, and overlapping, decurrent at the dorsal side, which has the margin plain to the apex, the ventral ciliato-dentate. Amentæ, at the incurved apex of shoots, formed of from four to seven pairs of altered leaves, saccate at the base, overlapping for one-third upwards, and enclosing the antheridia, which are large, obovate to sphærical in shape, with a well-marked hyaline ring, pseudopodia as long as the antheridia, of which there are three in the saccate base of each altered leaf.

11. *Jungermania barbata*, Schreb. Hook. Brit. Jung., tab. 70. Among rocks in the demesne, April, 1895.

12. **Jungermania attenuata*, Lindenberg. *J. barbata*, *β minor*. Hook. Brit. Jung., t. 70, figs. 18–22. Carr. and Pearson's Exic., No. 74. *J. gracilis*, Schleich, Lindb., in Mus. Scand. p. 7. Amongst rocks growing with *Leucobryum glaucum*, Hampe, and with

Tetraphis pellucida, at Ballykill plentiful, June, 1893, Feb. 1894. Howth demesne very fine, April, 1895. New to the Irish Flora.

13. **Jungermania ventricosa*, Dicks. Hook. Brit. Jung., tab. 28. Among rocks, Ballykill, 1894–5. In the demesne, 1895.

14. **Jungermania alpestris*, Schl. Exs. II. 59. Carrington and Pearson's Exic., 109. On a damp bank at the rabbit-warren near the "Ben," very rare, April, 1893.

15. **Jungermania bicrenata*, Lindenberg. Syn. Hep., p. 82. Under *J. excisa*, Sm. Eng. Bot., tab. 2497. On the hard peaty soil at Ballykill, 1893–4, in the demesne, April, 1895, very rare.
Pellia epiphylla, Linn., *var. endivæfolia*, Dicks. Thallus linear, elongated. Diœcious. In a marshy place at Kilrock Quarries, 1893.

16. *Blasia pusilla*, Linn. Sp. Pl. 1605. Hook. Brit. Jung., tab. 82–84. Boggy place at Ballykill (fertile), March, 1894.
**Metzgeria furcata*, Linn. *Proliferous form*, with young plantlets budding from the margin of thallus of the parent plant. On the stems of trees near the ground by the side of a stream near Howth village, March, 1894. Damp bank at a small bog, Ballykill, 1895.

17. **Riccardia latifrons*, Lindberg. Nat. Soc. Fl. Fenn., 13, p. 372. Hook. Brit. Jung., tab. 45, figs. 4–7 *et* 12. Autœcious, rarely parœcious, large, pellucid, thallus long and broad, divided into wide stag-horn-like lobes, more or less oblong, wedge-shaped, very obtuse, and emarginate, plano-convex. Cells large, oblong, rhomboid; perichætial bracts few; calyptra large and less verrucose than in *R. multifida*. Andrœcium, narrow, oblong, almost affixed to the side of the perichætium. Lindberg[1] in *Hepaticæ in Hibernia mense Julii*, 1873, *lectæ*. On a small bog at Ballykill, 1893–4, in the demesne, fertile (parœcious), April, 1895.

18. **Lunularia cruciata*, Linn. (Dumort.), *L. vulgaris*, Micheli. Nov. gen. 4 t. 4. On damp ground in the demesne, April, 1895.

19. *Conocephalus conicus*, Neck (Dumort.), *Marchantia conica*, Eng. Bot. t. 504. Bank of a small stream which flows into the sea near the Baily Lighthouse, February, 1894. Stream near Howth village, April, 1893.

[1] Acta Societatis Scientiarum Fennicæ, x.

	Ireland.	England (Yorkshire).	Scotland.	Pyrenees.	France.	Germany.	Scandinavia.	Extra European.
Frullania dilatata, . . .	×	W. E. N. ×	×	×	×	×	×	Teneriffe.
,, tamarisci, . .	×	W. N. ×	×	×	×	×	×	N. & S. America.
Lejeunea serpyllifolia, .	×	W. N. ×	×	×	×	×	×	N. & S. America.
,, flava var., . .	E & S W ×	..	S. W. ×	..	..	..	..	W. Indies; S. America.
Radula complanata, . .	×	W. E. N. ×	×	×	×	×	×	W. Indies, C.B.S.; Madeira; Teneriffe; N. & S. America; N.Z.
Kantia trichomanes, . .	×	W. E. N. ×	×	×	×	×	×	N. & S. America.
Lepidozia reptans, . .	×	W. E. N. ×	×	×	×	×	×	N. America.
,, cupressina, . .	E & S W ×	W. rare ×	..	..	×	×	..	W. Indies; N. America.
,, setacea, . . .	×	W. E. N. ×	×	×	×	×	×	N. & S. America.
Cephalozia catenulata, .	×	W. N. ×	×	×	×	×	×	—
,, multiflora, . .	E. ×	W. E. N. ×	×	×	×	×	×	N. & S. America.
,, bicuspidata, .	×	W. E. N. ×	×	×	×	×	×	Java; C.B.S., Falklands.
,, Lammersiana, .	×	W. E. N. ×	? ×	..	..	..	..	N. America.
,, connivens, . .	×	W. E. N. ×	×	×	×	×	..	—
,, curvifolia, . .	×	W. & N. ×	×	×	×	×	×	S. America.
,, Francisci, . . .	Howth. ×	N. ×	×	×	×	×	×	—
,, fluitans, . . .	E. & W. ×	N. ×	..	..	×	×	×	—
,, sphagni, . .	×	W. E. N. ×	×	×	×	×	×	Abyssinia; N. & S. America.
,, denudata, . .	E & S W ×	N. ×	..	×	..	..	×	N. & S. America.
,, divaricata, . .	×	W. E. N. ×	×	×	×	×	×	—
,, elachista, . .	S. & E. ×	..	×	..	..	×	×	—
Scapania resupinata, . .	×	W. E. N. ×	×	..	..	..	×	Teneriffe.
,, æquiloba, . .	N. & E. ×	W. N. ×	×	×	×	×	×	—
,, aspera, . . .	×	W. N. ×	..	..	..	×	×	—
,, nemorosa, . .	×	W. N. ×	×	×	×	×	×	Java; N. & S. America.
,, undulata, . .	×	W. E. N. ×	×	×	×	×	×	Canaries.
Diplophyllum albicans, .	×	W. E. N. ×	×	×	×	×	×	Madeira; N. & S. America.
,, minutum, .	E & S E ×	W. N. ×	×	×	×	×	×	—

	Ireland.	England (Yorkshire).	Scotland.	Pyrenees.	France.	Germany.	Scandinavia.	Extra European.
Lophocolea bidentata, .	×	W.E.N. ×	×	×	×	×	×	W. Indies; N America; N.Z
,, heterophylla,	×	W.E.N. ×	..	×	×	×	×	Canaries; N. America.
Chiloscyphus polyanthus,	×	W.E.N. ×	×	×	×	×	×	N. America.
Plagiochila asplenioides, .	×	W.E.N. ×	×	×	×	×	×	N. America.
Nardia crenulata, . . .	×	W.E.N. ×	×	×	×	×	×	—
,, gracillima, . . .	×	W. N. ×	×	×	×	×	×	—
,, scalaris, . . .	×	W.E.N. ×	×	×	×	×	×	—
Jungermania sphærocarpa,	×	W. N. ×	× ?	×	×	×	×	—
,, barbata, . .	×	W. N. ×	×	..	×	×	×	Pike's Peak, N America.
,, attenuata, .	Howth. ×	W. N. ×	×	..	×	×	×	—
,, ventricosa, .	×	W.E.N. ×	×	×	×	×	×	Pike's Peak, N America.
,, alpestris, .	×	W ×	×	×	×	×	×	—
,, bicrenata, .	E S & W ×	W.E.N. ×	×	×	×	×	×	—
,, incisa, .	×	W.E.N. ×	×	×	×	×	×	N. America.
,, inflata, .	×	W.E.N. ×	×	..	×	×	×	—
Saccogyna viticulosa, . .	×	W. ×	×	×	×	×	×	Canaries; Tene riffe.
Cesia crenulata, . . .	×	×	× ?	..	..	..	..	—
Pellia epiphylla, . . .	×	W.E.N. ×	×	×	×	×	×	N. America.
,, calycina, . . .	×	W.E.N. ×	×	×	..	×	×	[Spitzbergen.]
Blasia pusilla, ...	×	W. N. ×	×	×	×	×	×	N. America.
Metzgeria furcata, . .	×	W.E.N. ×	×	×	×	×	×	Australia; N.Z.
,, conjugata, . .	×	W. N. ×	× ?	..	×	×	×	N. & S. America Australia.
Riccardia multifida, . .	×	W.E.N. ×	×	×	×	×	×	N. America; W Indies; Falk lands; N.Z. Australia; [Nova Zembla
,, latifrons, . .	E. & S. ×	N. ×	? ×	..	..	..	×	—
,, pigunis, . .	×	W.E.N. ×	×	×	×	×	×	N. & S. America
Lunularia cruciata, . .	×	W.E.N. ×	×	×	×	×	×	Azores; Canaries
Conocephalus conicus, .	×	W.E.N. ×	×	×	×	×	×	Azores; N. America.

VIII.

A STUDY OF THE LANGUAGES OF TORRES STRAITS, WITH VOCABULARIES AND GRAMMATICAL NOTES. (PART II.) BY SIDNEY H. RAY, Member of the Anthropological Institute, and ALFRED C. HADDON, M.A., Royal College of Science, Dublin.

[Continued from the PROCEEDINGS, Ser. III., Vol. II., p. 616.]

CONTENTS OF PART II.

VIII.—SKETCH OF SAIBAI GRAMMAR.

There is only one text available for the elucidation of Saibai grammatical forms. This is a translation of the Gospel of Mark (16) made by Elia, a native of Lifu, who was placed on the island of Saibai by the London Missionary Society. Sharon's Vocabulary (MS. 8) contains the terminals and pronouns, and there are also a few sentences taken down at Muralug by one of us, and others from Saibai and Boigu at the end of Sir W. MacGregor's Vocabulary (23). But by far the most valuable grammatical notes on the language are those found in the Kowrarega (Muralug) Vocabulary of Macgillivray, which represent substantially the same language as the Saibai translation.[1]

With these materials we have done our best to draw up a Grammar of the Language, but it is doubtful whether the whole is strictly

[1] These were based on communications made by Mrs. Thomson (Gi'om), a white woman who had been held in captivity by the natives of Muralug for more than four years ["Voy. Rattlesnake,'" I., p. 301].

accurate. It will, however, form a basis for future investigation and may thus lead in the future, to more accurate knowledge. Macgillivray felt the want of accuracy in his materials, and in the introduction to his Vocabulary writes thus :—

"For the materials composing the Kowrarega Vocabulary, I am almost entirely indebted to Mrs. Thomson. Unfortunately, however, her total want of education prevented her from acquiring any idea of the construction of the language; nor could she always be made to understand the meaning of a question—however simple in its form—framed to elicit information on this point. Even by carefully sifting at leisure hours the mass of crude materials obtained from her and written down at each interview, day by day, I did not make sufficient progress in the grammar of the language to enable me to pursue the subject further, until her value as an authority had so far declined that it was prudent to reject it altogether. Nearly all the words originally procured from Mrs. Thomson were subsequently verified either by herself or by our Kowrarega visitors" ["Voy. 'Rattlesnake,'" II. p. 277].

The Saibai translation was printed in Sydney, and was apparently never revised by the translator or by anyone conversant with the language. It contains numerous typographical errors; words are wrongly divided, and probably often mis-spelled. Many phrases defy all attempts at analysis even when the English and Lifu equivalents are well known. The translation had therefore to be very cautiously used. It has been necessary to consult throughout the version in the translator's native tongue, and many references to the latter will be found in the pages of the Grammar.

The Saibai version was no doubt made from the Lifu New Testament of 1873. Of this we find evidence as follows:—

1. Mark, i. 19. The Saibai has *Iakobou Lebedaio*, James *of* Zebedee, following the Lifu idiom in *Iakobo i Zebedaio*. (*Lebedaio* is a printer's error for *Zebedaio*.)

2. Mark, vi. 35. "The time is far passed," is translated *paupa kutrapa*, literally the Lifu *heji hë*, it is evening.

3. Mark, VI. 48. In *senabi waci kubil tonar foa*, the fourth watch of the night, *waci* is the English word *watch* (Lifu *c* = *ch*) and occurs in the Lifu version in the same place; *ngöne la waci ne jinte hna eken*.

4. Mark, x. 4. "Put her away" is translated *palamulpa gudä*

waean, put them two away, and follows the Lifu *mate sei nyidoti pi*. *Palamulpa* and *nyidoti* are dual pronouns. In Lifu a married woman is supposed to have a child, and is usually addressed by courtesy as "*you two*."

5. Mark, x. 34. "The third day" is translated *goiga thrin*, from the Lifu *la drai hna thrin*. In both versions *thrin* is the English numeral *three* with the Lifu causative suffix *n*. Cf. a similar instance in Miriam, Pt. I., p. 525.

6. Mark, xvi. 10. The words "she went" are rendered *palae uzarman* from the Lifu *hnei nyidoti hna tro*, they two went (lit. by them two gone). Mary Magdalene, being regarded as a married woman, is spoken of as though having a child.

7. The word *a* is frequently used as a verbal particle in the Saibai translation, and especially when it is so used in the corresponding Lifu phrase. Cf. in Mark, xiv. 37. Saibai: *Noi mangizo a iman tana a utui*. Lifu: *Hnei anganyidëti hna hlepëti a öhnyi angate a meköl*.

8. The characters *ö*, *ë*, *tr* for *t*, *dr* for *d*, show the Lifu basis of the orthography.

9. English, Greek, and Samoan words introduced have the same form in Lifu and Saibai; e.g. *wan* (one); *gavana* (governor); *waina*, (wine); *kiona*, (χιων); *setauro*, (σταυρον); *kumete*, (*Sam*. 'umete).

There are some interesting instances of adaptation by the translator. These give us glimpses of the life of the Torres Straits' natives. The exact rendering of the Lifu has, in some cases, been modified in order to obviate the necessity of explanation or to suit the comprehension of the native mind. Thus the statement in Mark, II. 3, "When they could not come nigh unto him for the press, they uncovered the roof where he was, and when they had broken it up they let down the bed whereon the sick of the palsy lay," is plainly inapplicable to the Torres Straits house. The native dwelling is usually a frail structure of bamboo, often with a sloped roof and thatched with leaves. The idea of four men carrying another upon the roof would be absurd. Though the Lifu version states that the bearers went to *la hune uma*, the top of the house, a phrase which is just as inapplicable to the sugar-loaf shaped houses of Lifu, it must be remembered that the Lifu version was made by a European, and that it was no doubt made clear in teaching that the house referred to was strong and flat-roofed. The translator of the Saibai Gospel avoided both explanation

and absurdity by stating that *tana arakato putran lagou kalangu*, "they cut a hole from the back of the house," which, with walls of pandanus leaves, could very easily be done.

Again, in Mark, v. 38, the phrase which is in English "them that wept and wailed greatly," and in Lifu, *angate a iluilu me iteijen me teije-keleqë*, is translated into Saibai as, *mura mai adan, a mainö kunaran paruia nidisö*, all shed tears and made mourning with foreheads of lime. In the islands of Mabuiag and Tud, mourners cover their bodies with a mud or paste made from crushed coral. (See Haddon, "Ethnography," in Journ. Anth. Inst., xix., pp. 403, 416.) Another curious phrase gives us a picture of the sick native running to the missionary or teacher for *göugu*, "physic." It occurs in the leper's appeal (Mark, i. 40), *sike ubinemepa ngulaig ngöna butupatan gouguan aima*, "if thou wilt, thou canst cleanse me, making physic." Jairus is made to say (Mark, v. 23), *kapusa ngi ngapa-usar nginu getö nabepa gamutaris a gouguan mani, a na igilenga*, "a good thing thou come, thy finger touch her, and bring physic and she lives."

In Mark, viii., "Peter took him," is translated: "*Petelu dimunu pagean*, Peter pinched him. A passage, similar to those here given, occurs in the Miriam Gospels (Mark, xv. 16). *Gair polisman Iesu kebi metaem tegared, nei Praitorio a polisman nosik taraisare;* the policemen took Jesus to a little house, name Praetorium, and bring a band (i.e. a row) of policemen. In the Straits the policemen stationed on each island are the representatives of authority.

As the Miriam Gospels were revised by the English missionaries, such phrases would no doubt be modified, but they have escaped notice in the unknown and unrevised Saibai version.

In the following grammar, examples from the Gospel are unmarked. Words and phrases from Macgillivray are marked (M), and from Sharon (S), MacGregor (B).

Dialects.

It is extremely difficult to define the dialectical differences in the speech of the western islanders of the Straits. There are certainly variations in pronunciation and enunciation, and these have caused various travellers to spell the same words in different ways. There is also, to some extent, a difference in the words used:—

1. *Kauralaig.*—In this division the natives of Muralug have been

considerably influenced by those of Australia, in the neighbourhood of Cape York. There has no doubt been a large amount of intercourse with the Gudang blacks, but this has not apparently affected the grammatical structure of the languages. The Gudang Vocabulary of Macgillivray shows numerous words identical with those of the islands, yet the agreements are all in the names of objects, not in verbs or pronouns. In Muralug words, as they appear in the vocabulary, the slurred pronunciation of words is often marked by the insertion of *r*. Example: *barit*, *mari*, *sarima*, *kăraba*, for *bait*, *mai*, *saima*, *kaba*, &c.

2. *Gumulaig.*—The speech of these islanders, in the centre of the Straits, probably represents the purest form of the language.

3. *Saibailaig.*—The islands inhabited by this division (Boigu, Dauan and Saibai) are very near to the Daudai coast, and have probably received words thence. MacGregor found that Saibai words were known to the natives of Mowat and Dabu, who, ignorant of each other's dialect, had to open a conversation in the island dialect. The names given to the natives of the mainland, opposite Saibai and Boigu, *Dabu-lai*, and *Toga-lai*, show what is probably the Saibai termination for a clan, *laig*. The names Dabu and Toga may be the Saibai, *darpa* and *tuga*, bush and mangrove. On the mainland, in the same neighbourhood, is the Mai Kussa, which in Saibai means Pearl River. In Boigu final ŏ is more clearly pronounced than in Saibai.

4. *Kulkalaig.*—These people occupy the eastern portion of the Straits, and are nearest to the Miriam. The language of Masig shows more words like the Miriam than that of any other of the islands.

§ I.—*Alphabet.*

1. VOWELS.—*a* as in *father*; *ă* as in *at*; *e* as *a* in *date*; *ĕ* as in *let*; *ė* as Lifu ë and French *e* in *le*; *i* as *ee* in *feet*; *ĭ* as in *it*; *o* as in *own*; *ŏ* as in *on*; *ö* as German ö in *schön*, or nearly as English *o* in *forty*; *u* as *oo* in *soon*; *ŭ* as in *up*.

MacGregor's Vocabulary has a few words with *ä* (*mäi*, *dadagäiga*), but no indication is given of the sound intended. In the other vocabularies these words are spelled with *a* or *ö*. The vowel *ö* represents a sound which varies between *a* and *o*, and some words appear to be spelled indifferently with *a*, *e*, *o*, or *ö*: e.g. *kai*, *kei*, *koi*, or *köi*; *sabi* or *söbi*; *kasa* or *kösa*; *mari* or *möri*. A few words in Macgregor have *ö* where others have *u*; e.g. *möi* for *mui*. The

Gospels have *töridiz* for *tauradiz*; *tanöriz* for *tanuriz*. At the end of a word *ö* is very common, and in that position was written *a* by Macgillivray. MacGregor notes that, in Boigu, final *ö* is more clearly expressed than in Saibai.

In a few cases *e* changes with *i*, *getö*, *gitalenga*.

2. Diphthongs.—*ai* as in *aisle*; *au* as *ow* in *cow*; *ei* as *ay* in *may*. Macgillivray wrote *ei* where the translation has *ai*.

3. Consonants.—*k*, *g*; *t*, *d*; *p*, *b*; *w*; *j*; *s*, *z*; *r*, *l*; *m*, *n*, *ng*. These are sounded as in English, *ng* being the *ng* in *sing*.

There is some confusion between the sounds of *t* and *d*, *p* and *b*, *s* and *z*.

In the Saibai Gospel *t* and *d* are often found with *r*, as *tr* and *dr*. These are not written in the vocabularies, and must therefore be regarded as due to the Lifu translator's pronunciation of the Saibai, as in Lifu, *t* and *d* are commonly strengthened with *r*.

Examples: *drurai*, *padra*, *drudrupizö*, for *durai*, *pada*, *dudupizö* and *tradiz*, *tridan*, *tronar*, *katro*, for *tadiz*, *tidan*, *tonar*, *kato*.

Macgillivray wrote *th* in a few words, *thi*, *thung*. *Th* is also found in introduced words. *F*, in *fad*, *lokof*, is a change from *p*. The distinction between *w* (consonantal) and *u* (vocal) has been better observed in Saibai than in Miriam. *J* is not found in the Gospels, and, in introduced words, is represented by *i*. MacGregor has *j* in a few words where others have *z*, *japulaika*, *japudamino*, *jaji*, for *zapulaig*, *zapudamoin*, *zazi*. Macgillivray also has *j* for *z*; *kaje*, *ajir*. *S* and *z* often interchange, *pudis* and *pudiz*; *musur*, *muzura*; *susu*, *suzu*. In some words Macgillivray wrote *ch* for *s*, *chena*, *china*, for *sena*, *sina*; and also used *sh* in *shuma* for *sumai*. He noted also that the Gudang tribe of Cape York substituted *ch* for *s* in pronouncing Kowrarega (*i.e.* Muralug) words. Words in *ch* and *sh* will be found in our vocabulary under *j*.

R is rarely found as an initial (cf. Miriam), but is common as a medial and final. It sometimes interchanges with *l*, *tardan*, *barpudan* for *taldan*, *balpudan*. For the insertion of *r* in Muralug words, see the preceding note on Dialect.

A few interchanges are found between *ng* and *n*; *ngursaka* and *nursak*. MacGregor has *gn* as well as *ng*, but this is probably an error in transcription.

4. Compound Consonants.—The only real compound consonants found (with the exception of *dr* and *tr* already noted) are *gw* and *kw*.

A few others result from the juxtaposition of two simple consonants through the omission of a vowel. Macgillivray wrote *ts* for *s* in *tsika* for *sikö*.

5. CONTRACTIONS.—A vowel is often dropped between two consonants, e.g. *klak*, for *kalak*; *krangipa* for *korongaipa*, *prateipa*, *purteipa*, in past, *purutan*. The final *ö* or *i* is often very indistinctly pronounced and is very frequently omitted. Macgillivray has the following note on contractions in Muralug:—

"Regarding the allusion to a terminal vowel, it may be mentioned here that as most Kowrarega words end in a vowel, its absence, when a vowel commences the following word, is commonly owing to elision. Ex.—'*udzu umai*, = my dog,' becomes '*udz'umai*.' When the last consonant in a word is the same as the first in the following word, one of the letters is omitted. Ex.—'*apa pirung*, = soft ground,' becomes *ap'irung*.' There are numerous other contractions, as '*ai*' for '*aidu*, = food'; '*aiye*' for '*aiyewel*, = come here'; '*mue utsem*, = the fire has gone out,' for '*mue utsimem*,' *&c*." [II. 279.]

§ II.—*Pronouns.*

1. PERSONAL.—These are declined as nouns by means of suffixes. Gender is distinguished in the first and third person.

The simplest forms are as follows:—

(*a*) *Nominative.*

Singular,
1. *ngai*, I (masculine); *ngazo*, *ngözo*, I (feminine).
2. *ngi*, thou.
3. *noi*, *nu* (S); *nuë* (M), he, it (masculine); *na*, she.

Dual,
1. inclusive of person addressed, *aba* (M); exclusive of persons addressed, *ngalbe*, *ngalabe*, *albei* (M), he and I.
2. *ngipel*, you two.
3. *pale*, *palae*, they two.

Plural,
1. (inclusive), *ngalpa*, *alpa* (M), you and I; (exclusive), *ngoi*, *ngöi*, we, they all and I.
2. *ngita*, *ngitana* (M), you all.
3. *tana*, *äri* (M), they all.

An analysis of the pronominal forms is not without interest. The *na* of the third person singular (fem.) is no doubt the same with the demonstrative particle *na*, and is found also in the third plural *ta-na*

combined with a plural demonstrative *ta*. In the second plural *ta* is combined with the pronominal word *ngi* as *ngi-ta*, and Macgillivray gives it with *na* also as *ngi-ta-na*. In the third person masculine *nu* or *noi* (with its drawled Muralug pronunciation *nuė*) is probably the same as the feminine *na*, for *o* frequently varies to *ŏ* and *a* (see § I., 1). The affix *i*, which is also found in the first person masculine, may, perhaps, mark the masculine, but is more likely to be the same with the demonstrative *i*. It occurs also in the first plural inclusive *ngō-i*, which is probably the same as *nga-i*.

The *pel*, *palae* of the dual is also found combined with the demonstratives, and is the root of the verb *palan*, to divide, open. It may also be used as a numeral. Latham suggested the meaning of 'pair,' and pointed out that the root *p-l*, or some modification of it, is the equivalent for *two* in very many of the Australian languages. Latham also noted the close correspondence of the Saibai (Kowrarega) use with that of the Western Australian language. "These so closely agree in the use of the numeral *two* for the dual pronoun, that each applies it in the same manner. In the *third* person it stands alone, so that in Western Australian *boala* and in Kowrarega *pale* = *they two*, just as if in English we said *pair* or *both*, instead of *they both* (*the pair*); whilst, in the second person, the pronoun precedes it, and a compound is formed; just as if in English we translated the Greek σφῶι by *thou pair* or *thou both*."[1]

The affixes *lbe* and *lpa* have a certain amount of likeness, though their presence in the *exclusive* dual and *inclusive* plural cannot be explained. The *l* may probably be the same as the plural suffix *l* (see § III.), whilst *be* and *pa* may be compared with the demonstrative *bi*, or with the dative suffix *pa*, towards, and the directive suffix *pa*. Without the affixes and demonstratives, the pronomial forms are reduced to two only, *nga* and *ngi* (for *ngo* or *ngō* in the plural exclusive is the same as *nga*, see § I). These two are, as Latham pointed out,[2]

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[1] "Remarks on Voyage of the 'Rattlesnake'" in Opuscula, p. 225, and Macgillivray, II. p. 333.

[2] The difference between the first and second persons being expressed by different modifications (*nga*, *ngi*) of the same root (*ng*), rather than by separate words, suggests the inquiry as to the original power of that root. It has already been said that, in many languages, the pronoun of the *third* person is, in origin, a demonstrative. In the Kowrarega it seems as if even the basis of the first and second was the root of the demonstrative also. ["Remarks on Voyage of the 'Rattlesnake,'" p. 333, and Opuscula, p. 225.]

probably modifications of the same root *ng*, and have a demonstrative origin. *Nga* is also the interrogative, who? and is found in the directive *nga-pa*, hither, to here.

(*b*) *Instrumental case.*

Singular, 1. *ngatō*, *ngatu* (M), (masc.); *ngōzo* (fem.)
2. *ngidō*, *ngidu* (M).
3. *noidō*, *nudu* (M), (masc.); *nadō*, *nadu* (M), (fem.)

No instrumental forms have been found in the dual and plural numbers. The suffix *du*, *tō* may be compared with the Miriam *de*. There seems little doubt but that this case corresponds to what has been called in Australian Grammars the nominative of the agent. As used in the Saibai Gospels, they express the person as the agent of an active verb.

Example: *ngatō tanamulpa waean*, I sent them away; *sike mata ngōzo gamuia tradiz nongo dumawakuia, wa, ngōzo igililenga*, if only I touch his garment, then I live; *Ioane siëi ngatō kuikō patan*, John there I beheaded, or beheaded by me; *ngido ngōna kasa wanan*, you have left me alone; *ngidō ngona mina mabaegadō maipa*, you make me a good man, i.e. call me good; *noidō mamain ita seven areto*, he took seven loaves; *noidō nubepa iman*, he saw him; *noidō noino waean tanamulpa*, he sent him to them; *mi watri pawa noidō mani?* what evil has he done? *nadō Petelun iman*, she saw Peter; *nadō ngaeapa mani*, she has done (it) to me.

The examples of the use of the nominative and instrumental pronouns collected by Macgillivray were too few to generalize upon. He noted, however, that *ngatu*, *ngidu*, *nudu*, *nadu* appeared "to be used only with a certain class of verbs, of which an example is afforded by the sentence '*ngatu nudu matumina* = I struck him'; and the use of the second set of these pronouns (i.e. the nominative) is illustrated by '*ngai nue*' (not *ngatu nudu*) *mulem*, &c., = I told him, &c.," [II., p. 299). The difficulty in Macgillivray's examples is that both subject and object have the same affix, but according to the analogy of the Gospel the sentence should be *ngatō noino mataman*, with an objective in *no*. His second example would be *ngai nubepa muliz*, I told to him. In many cases the ordinary form of the nominative is used instead of the instrumental forms.

(*f*) The *Ablative* is shown by the suffix *-ngu*, fem. *s*.

Singular, 1. *ngaungu.*
2. *nginungu.*
3. *nongonongo, nungungu,* (masculine); *noi gungu, nanus* (feminine).

Dual, 1. (*not found*).
2. (*not found*).
3. *palamulngu.*

Plural, 1. (*not found*).
2. *ngitamulngu.*
3. *tanamulngu.*

In the singular *ngu* is added to the possessive forms, except in the third feminine, which has the ablative suffix *s* (or *si*) ordinarily used with demonstratives. (See Adverbs, § VI.) In the plural and third dual *mul* is inserted as in the dative forms.

Examples: *Tanamun korkak ngaungu koi sigal,* their hearts are far from me; *ngi adapadan, watri mari, nungungu mabaegöngu,* come thou out, bad spirit, from him, from the man; *börodan kadaipa mani nabi ai noi nungu,* the earth brings forth the food from itself; *noidō sevene demoni nguroweidan nanus,* he had cast out seven demons from her; *tana getöwani palamulngu,* they released them two.

(*g*) The *Ergative*.—This is shown by the suffix *ia* which is given in Sharon's Vocabulary as the equivalent of "with." The Gospel usually agrees, but in some cases it is difficult to apply this translation. (See more fully in Nouns, § III.)

Singular, 1. *ngaibia.*
2. *ngibia.*
3. *nubia.*

Dual, (*not found*).

Plural 1. (*not found*).
2. *ngitamunia.*
3. *tanamunia.*

In the singular *ia* is added to the nominative, with the demonstrative *bi* inserted. In the plural *ia* is added to the possessive forms.

Example: *Ngaibia kaimi,* follow me (be mate with me); *nga mabaeg ngaibia garabō tradis?* Who touched me? *tanamun utuilō ita*

ngaibia, they have been (their abiding is) with me; ***mabaeg ina nibuwanan ngibia amadan***, love the man near thee; ***Iesu nubia gimal tanoriz***, Jesus sat on top of him; ***palae matadōbura getōwaniz senabi palamun api a nubia kaimi***, they immediately left their nets and followed him; ***keda maigi ngitamunia***, don't let it be like (that) with you; ***areto midō siëi ngitamunia?*** how many loaves have you (what loaves there with you)? ***ngoi muia utiz tanamunia***, we enter into them; ***tanamunia ai aiginga***, they have no food.

For the suffix ***ia***, in the sense of "have, possess," see Nouns, 4 (*g*).

(*h*) The *Locative* suffix ***-nu*** is not found in use with pronouns. The suffixes ***nanga*** and ***nge*** are discussed in the section on Nouns.

(*i*) A suffix ***ka*** appears with the pronouns ***ngi*** and ***ngita***, but its meaning is not very clear. It may be an abbreviation of the future particle ***kai***.

Example: ***Ngika lakō uzar nginu lagōpa***, go home again to thy house; ***ngitaka mata korawaig?*** don't you perceive?

(*j*) *Self* is expressed by the addition of ***kusaig*** to the singular pronouns ***ngai*** and ***ngi***; ***ngaikusaig***, myself; ***ngikusaig***, thyself. In the plural the pronoun is reduplicated, ***ngōingōi***, ourselves; ***ngitangita***, yourselves; ***tanatana***, themselves. In the third singular, himself is expressed by the simple pronoun ***noi***.

Example: ***Mipa ngitangita ia uman?*** why did ye dispute among yourselves? ***aipa baropudaipa tanatanamulpa***, to buy food for themselves; ***durai noidō igilipaliz, a kōrawaig noino igilipalan***, he saved others, and he cannot save himself; ***kapusa noi ubigiasin noi***, let him deny himself; ***Kusaig*** is also used for "alone." ***Iesu mata nongo kusaig siëi lagonu***, Jesus (was) there alone (only Himself) on the land.

2. INTERROGATIVE PRONOUNS.

(*a*) The personal interrogative is ***Nga?*** who? declined as follows:—

Nominative, ***nga?*** who?
Instrumental, ***ngadō?*** by whom?
Accusative, ***nganō?*** whom?
Possessive, ***ngonu?*** whose?

The dative, ablative, locative, and ergative do not appear.

Example: ***Nga ngulaig igililenga?*** who can be saved? ***ngau dumawakuia ngo garabōtradiz?*** who touched my clothes? ***ngai nga?*** I am who? ***nga ngibepa poiban senabi mura za ina?*** who gave thee all

these things? *ngadō mani?* who took it? *ngadō kula taean?* who rolled away the stone? *ngonu paru ina?* whose face is this?

Nga is sometimes added to other words. Example: *Nga mabaeg ngaibia garabōtradiz?* who (what man) touched me? *nginu nelenga?* who is thy name? (cf. the Melanesian use of 'who' in asking a name).

(*b*) The interrogative used of things is *miči?* what? The following forms are found:—

Nominative, instrumental, and accusative, *miči? midō?* what?

Dative, *mipa?* for what? why?

Ablative, *mingu?* from what? concerning what? why?

The distinction between *miči* and *midō* is not clearly made out in the Gospel, but *midō* from its form should be instrumental.

Example: *Midō ngai?* is it I? or, do I do it? *miči ngi ubinmepa?* what do you wish? *kuikulumai vine apangu miči mani?* what did the lord of the vineyard? *ngai midō mepa ngibepa?* I do what for thee?

Miči is sometimes reduplicated. *Mičimiči sena noi keda augadapa ipidadō-pugan?* why does he thus blaspheme God? *mičimiči* is also used for 'which?' (of two) in Mk. II. 9.

(*c*) *Mi*, the root of *miči*, *midō*, is used prefixed to nouns as an interrogative adjective with the meaning 'what?' 'what sort of?'

Example:—*Miza?* what thing? *mi watripawa?* what evil? *mi tonar?* what sign? *mi lagō?* what place? *mi ia umamōipa?* what discussion? *mi muamu?* what wisdom? *Ngalpa Augadan baselaia mi ngadalnga minapa?* we make God's kingdom like what?

For *mipa* and *mingu*, see Adverbs, § VI.

3. Demonstrative Pronouns and Adjectives.—These are formed by various combinations of particles, of which the separate meanings are not very clear. It seems possible, however, to classify them as follows:—

na, *bi*, simple demonstratives, directing attention.

Place, { *i*, place near; here. *se*, place, distant; there. Cf. adverb, *siei*, *sei*, there. }

Number, { *pel*, *pal*, dual. Cf. pronouns, *palae*, they two; *ngipel*, you two; verb, *palan*, divided. *ta*, plural. Cf. pronouns, *tana*, they two; *ngita*, you two. }

The combinations give the following words in the vocabularies and Gospel:—

ina, *inō*, this one, the, here; *nabi*, *inabi*, this, the, a; *inabi durai*, these.

nabi, that, the.

ipal, the, these two, both.
ita, the, these; often used as a kind of plural article.
sena, that; *senabi*, the, those; *senabi durai*, those.
sepal, those two, both; *sepalbi*, those two.
seta, those; *setabi*, those.
tabi, those.

Example: *Ina, inō: ina koi sabi*, this (is) the great law; *wara tanamun inō*, this is one of them; *ngai inō*, it is I; *Keriso inō*, here is Christ.

nabi: nabi ia, the word.
inabi: inabi kawa, the people.
ipel: ipel, both (Macgillivray).
ita: ita watri maril, the evil spirits; *ita kaziel*, children.
sena: sena noi, that same is he.
senabi: senabi mabaeg utun, the sower; *tana iman senabi mabaeg*, they saw the man; *senabi Iakobon kutaig*, the brother of James; *senabi nongo igalaig*, his friends; *senabi parpar ina*, such mighty works.
sepal: ngipel sipalsei kai mangeman, you two there, shall come.
sepalbi: sebalbi sōbi, those two laws.
seta:
setabi: setabi magina köziel, those little children.
tabi: tabi göiga siei, those days there.

Some of these words are used with a locative sense, and as equivalents to the Lifu prepositions *ngone*, *kowe*, etc., with the article. Cf. § VII.

4. INDEFINITE PRONOUNS AND ADJECTIVES.—*Wara*, a, one, any, another, a certain, cf. numerals; *du*, *ita du*, *durai*, some; *mura*, many, all; *sepal*, both; *urapa*, the same; *wara . . . wara*, the one . . . the other; *wagedō*, the other; *manarimal*, a few; *za*, *zangu*, something (existing); *pawa*, something (performed); *ia*, something (said); *mi mabaeg*, whoever, what man.

§ III.—*Nouns.*

1. NOUN FORMS.—A verb or adjective may be used as a noun without change of form; *ngulaig*, to be able, able, ability.

The suffix *izinga*, and its plural *moizinga*, appear to form nouns from a verbal root, and are thus used in the Gospel with possessive pronouns.

Example: *nidisō*, to do; *nongo nidaizinga*, his doing (Lifu, *la hnei nyidëti hna kuca*, the by him deed); *tanamun ngurupaizing*, their doctrine; *ngitamun kōrngaizinga*, what you have heard; *tanamun imaizinga*, thing they had seen; *mabaegau iautumoizinga*, men's commandments (Lifu, *la ite thina hna ahnithe hnei at*, things ordered by men); *Augadan kalmel manamoizinga*, God's joining together (Lifu, *la hnei Akötesie hna icasikeun*, the by God joined); *wara köi ngabad gimal poidamoizinga a butupataizinga*, a large room above, furnished and prepared.

These suffixes appear to be used of persons, as well as of things. *Tana nubepa ngurōwoidan getōlangaizinga*, they cast him out, shamefully handled (*lit.* a spoiled thing).

A suffix *lai* seems to form a verbal noun in the words: *toitupagailai*, prayer, from *toitupagaipa*; *nginu kapuakasilai*, your faith, from *kapuakasin*; *silamailai*, an uproar, from *silamai*, to fight. Other examples present some difficulty. *Tana getōwanizō senabi umaulai dōgam utui*, they let in the bed wherein the sick man lay.

The person performing an action is denoted by the noun *mabaeg*, plur. *mabaegal*, following the verbal root; *api-angai mabaeg*, fish-trap-setting man; *mamoe danalpatai mabaeg*, shepherd, sheep-watching man; *minarō pōlai mabaeg*, writer, mark-cutting man. Persons belonging to a place are distinguished by the suffix *laig*: *Nazareta laig*, man of Nazareta; *Saibai laig*, *Badulaig*. Hence also the names of the islanders of the Straits, though these are formed from the names of parts of the body and not from names of places: *Kaura-laig*, ear-people; *Gumu-laig*, body-people; *Kulka-laig*, blood-people. Similarly *laig* is used with other nouns: *kikiri laig*, sick person or people; *maidëlaig*, sorcerer; *igalaig*, kinsman.

In Mark, ix. 50, *laig* is abbreviated to *lg*, and appears in the plural: *kapusa ngita alasilgal*, have salt in yourselves, *lit.* good thing (if) ye (are) salt people. In Mark, vii. 26, is *lg*, with the dative suffix, *demonilgōpa*.

The word *igal*, suffixed, appears sometimes to form a personal noun, but its use is not very clear. *Ngita muamuagigal, ngita imaigigal*, you (are persons) without understanding, you do not see. In these examples the first *g* represents the negative. The affirmative has *zi*. *Tana imaizigal*, they that saw it.

Some adjectives are used with the word *idaig*, plur. *idaigal*, to form presonal nouns. *Ngōlkai idaigal*, hypocrites; *tratra idaig*, a stammerer.

Mael, *mail* also appears as an affix forming nouns from verbs: *umamail*, the dead; *burugõmulmael*, the harvest, the ripening; *igililemael*, the living; *kousagimael*, the non-fruiting; *nongo butapõtaizimael* his healings, those he had healed. The last three examples show the insertion of the affixes *le* (possessing), *igi* (wanting) and *zi* (thing). In *mael*, *ma* may be compared with the *ma*, *mu* of plural verbs, and *l* with the noun plural.

The instrument with which an action is performed is sometimes expressed by the word *za*, (thing) following the verb.

Example: *niai za*, a chair, sit-thing.

2. NUMBER.—The dual is expressed by the numeral *ukasar*, two, by the dual demonstratives, *sepal*, *sepalbi*, or by the dual pronoun, *palae*.

Ukasar wapi, two fishes; *ukasar dimur*, two fingers; *sepal giginõ kazi*, two sons of thunder; *sepal magina mani*, two little (pieces of) money; *sepalbi sõbi*, two laws; *palae api-angai mabaeg*, two fisher-men. Sometimes numeral and demonstrative are both used. *Sepalbi ukasar angai-dumawaku*, two garments.

The plural is indicated in various ways.

(*a*) By suffixes, *-l*, *-al*, *-el*, *-öl*, *-lö*: *Umail*, dogs; *tabul*, snakes; *sabil*, laws; *kusal*, beads; *mabaegal*, men; *babatal*, sisters; *pui-tamal*. branches; *kaziöl*, children; *ianalõ*, baskets.

(*b*) By the plural demonstrative *ita* with or without the suffix: *Ita kazil*, children; *ita apal*, lands.

(*c*) By the plural pronouns: *Tana minarpõlai mabaeg*, the scribes.

(*d*) Definitely by numerals, with or without the adjective *gõrsar*: *Tuelv iana*, twelve baskets; *tuelv gõrsar nanu watal*, twelve were her years; *foats köigõrsar gõiga*, forty days.

(*e*) By the adjectives *durai*, some; *mura*, all; *gõrsar*, many, or *kõigõrsar*, great many, with or without the demonstrative or suffix: *Durai nginu kutaig*, thy brothers; *durai kikiri*, some sick; *mura kikiri laig*, all the sick folk; *ita durai mabaegal*, some men; *mura mabaegau kõziel*, men's sons.

(*f*) By context: *Ngapa mangizõ urui palgizö a purutamoin*, forth came birds and ate (*purutamoin*, plur. verb).

Macgillivray has the following note on plurals in Kowrarega (*i.e.* Muralug):—

"To form the plural of a noun or adjective, the rule appears to be to add *le* as a postfix, sometimes previously supplying a terminal

vowel if required. Example: '*geta* = hand' becomes '*getale*' in the plural; *kuku* = foot, *kukule*; '*kutai* = yam, *kutaile*'; '*ipi* = wife, *ipile*'; '*kerne* = lad undergoing a certain ceremony, *kernele*'; '*makaow* = mat, *makaowle*'; '*bom* = fruit of pandanus, *bomale*.' There are exceptions, however; '*mari* = shell ornament,' makes '*marurre*' in the plural; '*gul* = canoe, *gulai*'; '*tawpei* = short, *tawpeingh*'; all nouns ending in *ra* have the plural in *re*, as '*kowra* = ear, *kowrare*'; and all ending in *kai* gain *jille* in the plural, as '*ipikai* = woman, *ipikaijille*'" [II. 279].

We have found no examples of plurals in *re*, *ai*, *ing*, or *jille* in the Gospel.

3. Gender.—Sex can only be expressed by the use of the words *gara*, *inile*, male, or *ipi*, *madale*, female. *Garakazi*, male person, boy, man; *ipikazi*, woman, female person; *ipikaji burumō* (B), a sow; *inil-tiam*, a male turtle. For literal meaning of *inile*, *madale*, see Vocabulary.

4. Case.—The noun is declined by means of suffixes. There appear to be nine cases, Nominative, Instrumental or Nominative of the agent, Accusative, Genitive, Dative, Ablative, Locative, Ergative, and Vocative.

(*a*) *Nominative and Instrumental.*

The nominative is the bare root. The instrumental is shown by a suffix. To agree with the pronouns, the suffix should be *dō* or *du*, but examples are not easily found, though we have in Mark, ix. 24, *maidō wokailnga*, cried out with tears. In most cases no suffix is used, and in others the termination (-*n*) is the same as the accusative.

Example 1: *Without suffix.*—*Gōiga palgizō*, the sun rose; *gubō papudamiz*, the wind ceased; *tati tarai walmizin*, the father quick cried out; *mui usimoiginga*, the fire is not quenched.

Example 2: *With suffix n*:—*Bōrodan kadaipa-mani nabi ai*, the earth brings forth food; *nongo gamu kulan lapan*, cut his body with stones; *war mabaegan Augadan baselaia ugan*, a man waited for God's Kingdom; *adapa idumoin moroigan*, to be rejected by the elders; *durai kawakun noino gasaman*, some young men laid hold of him.

(*b*) *Accusative.*

As a general rule the noun in this case does not differ in form from the nominative, but a suffix -*n* is also found, especially with proper

names. This agrees with the accusative suffix in the pronouns *ngöna*, *nginö*, *nöino*. There seems, however, to be some confusion between the nominative and accusative.

Example 1: *Without suffix*:—*Noi purutan pukatō*, he eat locusts; *tana iadupalgan tanamun watri pawa*, they declared their bad deeds; *nginu dokam mani*, take thy bed.

Example 2: *With suffix*:—*Nadō Petelun iman*, she saw Peter; *Tana Iesunō gasaman*, they took Jesus; *gouguan mani*, bring medicine; *danal patamoiziu ita minarpōlai mabaegan*, watch the scribes; *kulun tariz*, to kneel (*kulu*, knee).

(*c*) *Genitive or Possessive.*

This is shown by the suffixes *u* or *n*, *ne*.

Example in *u*:—*Kōziu tati*, the child's father; *pudau kuta*, a reed's point; *Iudaialaigau kuikulunga*, Jew's King; *mabaegau iautumoizinga*, man's commandments; *alasiu ter*, salt's flavour.

n:—*Augadan baselaia*, God's kingdom; *Mosen tusi*, Moses' book; *Simonane lagō*, Simon's house; *giginō kazi*, thunder's child; *asinan kazi*, asses' child (foal); *Simonan ipiu apu*, Simon's wife's mother.

There seems to be no distinction between *u* and *n*. It is indifferently *augadau* or *augadan*, *asinau* or *asinan*. There is a peculiar use of the genitive to denote "son of," e.g. *Iakobou Alefaio*, James son of Alpheus; *Iakobou Zebedaio*. This is evidently not a Saibai idiom, and is due to the translator's imitation of the Lifu *Iakobo i Alefaio*, *Iakobo i Zebedaio*, in which *i* is the genitive preposition. The meaning has, however, been curiously reversed, the Saibai being "Alphæus of James" and the Lifu "James of Alpheus."

(*d*) *Dative.*

The dative denoting motion to, or purpose for which a thing is intended, is shown by the suffix *pa*. It may be compared with the directive *ngapa* and the verbal prefix *pa*.

Example: *mabaegōpa*, to a man; *padapa*, to a hill; *daparpa*, to the sky; *muiapa*, into the fire; *wara mabaegōpa mulaigi*, don't tell (to) any man.

In names of persons *l* is usually inserted between the name and the suffix. Cf. *l* in the pronominal suffix *mulpa*.

Example: *Simonalpa*, to Simon; *Iesulpa*, to Jesus.

With names of places, the suffix is used, *Galilaiapa*, to Galilee;

and the meaning of "into" is also expressed by the word *au* before the noun. *Noi mangiz au Kaperenauma*, or by the adverb *sei*, there. *Tana mangizö sei Kaperenauma*, they went there (*i.e.* to) Capernaum.

For verbs governing the dative, see Syntax.

(*e*) *Ablative.*

The ablative expressing motion from, or origin, is shown by the suffix *-ngu*, and may be translated "from, through, or concerning."

Example: *Ngukingu*, from the water; *sunagngu*, out of the synagogue; *noi ngitamulpa bapataiso maringu*, he baptises you from the Spirit; *nadö Petelun iman muingu koamapa*, she saw Peter warming himself from the fire; *pepe baradarangu*, from the thinness of the earth.

With personal nouns *l* is inserted as in the dative.

Example: *Heroda Ioanelngu akan*, Herod feared John; *marilngu*, from the Spirit.

For verbs governing the ablative, see Syntax.

(*f*) *Locative.*

The locative meaning on, in, or at, is expressed by the suffix *nu*.

Examples:—*Doidönu*, in the wilderness; *iabugudanu*, on the road; *nongo purukanu*, on his eyes; *tanamun koikaknu*, in their hearts; *lagonu*, in the house.

There is another way of expressing the locative by the word *au*, in.

Example:—*Ioane bapataiso nubepa au Ioritana*, John baptised him in Jordan; *taimanu au Dekapoli*, on the border in Decapolis; *au gulai*, in a ship.

The demonstrative *senabi* is very often used to translate the Lifu *ngöne la*, in the.

Example:—*Nurö walömizin senabi döid*, a voice crying in the desert; *mura mudö garoweidamoin senabi pasa*, all the crowd assembled at the door.

(*g*) *Ergative.*

The ergative expresses the doing of a thing by means of, or at the same time with, another It is shown by the suffix *ia*, and is translated "with" in Sharon's vocabulary, but the exact meaning seems difficult to define. A reciprocal meaning is sometimes present, e.g. when two things come in contact *ia* is used. Sometimes the meaning "by, alongside." Cf. the following examples:—

Noi usar a nabepa getia ielepan, he came and took her by the hand; *lagö ngipen paruia*, village in front of you; *nongo igalgia*, among or by

his kinsmen; *mata karengemin noi siëi ipokōzia kazilaig ngawakazi*, but heard of him there by a woman having a daughter; *tana wanan mura mabaegia paruia*, they put them before all the men; *noi kalia znagi*, he looked back; *gubō paruia*, wind (was) contrary; *Iesu muia utiz lagia*, Jesus was come into a house; *noi maluia uzar*, he walked on the sea; *muia utemin ita burumia*, entered into the pigs.

Since this suffix gives the meaning of the Lifu, *thei*, with, which is idiomatically used for "have," we often find it used for "have" in the Saibai version, especially with pronouns, e.g. *areto sei ngitamunia midō?* what bread have you? (Lifu, *ije areto thei nyipunie*, how many loaves with you?)

(*h*) *Vocative.*

The vocative is shown by the suffix *ae* or *ëe*.

Example:—*ngurupai-mabaegae*, O teacher; *ngau kaziae*, O my daughter; *Davitan kaziae*, O son of David; *ngawakaziëi*, damsel.

The words *Baba!* my father! *Ama!* my mother! are used instead of the common *tati* and *apu*. For a few other examples, see § IX., 3.

(*i*) There are other noun terminations, of which the use is not very clear. All that can be done here is to give some examples.

These endings are *nge*, *nanga*, *tai*, *ai*, *du*, *bo*, *bōu*, *utu*, *asin*, *gar*.

Example: *Nge: Ngi ngōnanumaiginga Augadau ia, a mabaegau iange*, thou rememberest not God's things, but men's things; *ngōde puinge*, like trees; *vineu ap wara mabaegpange turan*, give the vineyard to other men; *ngita muasin nubepa kidötaean sakai puru mabaegou lagonge*, ye have made it a den of thieves; *noi keda ngadalnga umangange*, he was as one dead; *ngau kusaig launga töridiz, a babange ngōna waean*, receiveth not Me, but the Father that sent Me.

Nanga: Poiban Mose nanga iautumiz, offer the things Moses ordered; *palae iamuliz tanamulpa keda Iesun iananga iautumiz*, they said to them as Jesus ordered; *midö ngita ngaeapa boie uzar keda puru mabaeg nanga midö?* are you come out to me as against a thief? *keda angela nanga*, like the angels; *koigörsar mabaeg wagel-nanga kulainge*, many men last (shall be) first; *iman keda noi nanga mido palamulpa iamuliz*, found as he had said to them.

Nenga is found in: *Nongo kapu minanenga*, his glory.

Tai: Nongo notai nidiz, touched his tongue; *mura mabaeg alasenu taean muitai*, every man shall be salted with fire.

Ai: *Gulai patiz*, get into the ship. Macgillivray gives *gulai* as the plural of *gul*, but there are no examples in the Gospel. (See Plurals, p. 136.)

Du: *Ngita tana aidu poiban*, give ye them food. The common form is *ai*, food. Macgillivray has (II., p. 313): "As examples of the various forms of this word, I may give, *ana pibur aidu* = give me (some) food; *ina aio?* = is this eatable? *ai* = it is eatable."

B, bö: This appears to be another spelling of the dative suffix *pa*. *Waliz gulab*, *walizö*, climb up into the ship. *Waliz gulpa* is also found.

Böu: *Koiaböu*, with a loud voice. *Koia* for *koi ia*.

Utu: This is, no doubt, connected with the verb *utui*, to lie down. *Ngawakaziutu lag*, the place where the girl was lying.

Asin: Perhaps connected with the verb-preposition *asin*, to be with. *Senabi nginu mekatasin*, in thy glory; *mekata*, shining, radiance.

Gar: *Palae getöwanizo Zebetaiogar palamun tati*, they left Zebedee their father; *nanu aigar barpudan*, all her living.

Some of these terminations are also found with pronouns. For examples, see Pronouns, § II.

(*j*) The possessive case of a pronoun is used with nouns in all cases. In this the Saibai use differs from the Miriam. (See Miriam Grammar, § III. *k*.)

Example: *Nongo kuikuigau nelpa*, to his brother's name; *ngau nelngu*, through my name; *nongo purukanu*, on his eye.

§ IV.—*Adjectives*.

1. A few adjectives are used in a simple form. *Koi*, *kai*, big; *magi*, little; *kapu*, good; *wati*, bad; *pepe*, thin.

2. A distinctly adjectival form is given to a word by the affix *nga*. *Keinga*, large; *mapunga*, heavy; *towanga*, easy; *piranga*, *pirung* (M), wet; *gögainga*, weak.

A few adjectives have the termination *na* instead of *nga*; *magina*, little; *sumein* (M), cold.

Adjectives of quality are formed by adding *le* (Muralug, *re*, *ri*) to the name of a quality or thing, with or without the ending *nga*.

Example: *Mita*, taste; *mitale*, *mitalenga*, *mitalnga*, tasty; *kula*, stone; *kulăle* (M), stony; *nisö*, leaf; *nisalnga*, leafy; *kulka*, blood;

kulkale, red; *kuama*, heat; *kuamalnga*, hot; *kaura*, ear; *kaurare kauralenga*, possessing ears; *getö*, hand; *gitalenga*, possessing a hand.

The negative of adjectives in *le* or *lenga* is formed by adding *igi*, *gi*, or *ge* to the noun, with or without the ending *nga*. Cf. Miriam adjective in *kak*, Daudai *tato*.

Example: *Soba*, slow; *sobaginga*, smart; *tari*, quick; *taregi*, slow; *kösi*, child, *kösiginga*, childless; *mabaegögi*, deserted; *mitaiginga*, tasteless.

When persons are qualified *gigal* is sometimes used. *Ngita muamuagigal, ngita imaigigal*, you (are) without understanding; you don't see.

A few adjectives are formed by reduplication as in Miriam.

Example: *Idi*, oil, *idiidi*, fat; *kubi*, charcoal, *kubikubinga*, black; *mudö*, crowd, *mudömudö*, crowded.

Macgillivray has the following note on this method of forming adjectives:—

"The formation of many adjectives can be clearly traced: in fact, one of the most obvious features of the language—imperfectly as it is understood—is the facility with which many nouns may be converted into either adjectives or verbs. Thus, '*mapei* = a bite,' becomes '*mapeile* = capable of biting,' and is the root of the verb '*mapeipa* = to bite.' The positive adjunct '*leg*,' and its negative '*aige*,' are also used to convert nouns into adjectives: the former follows the same rules as those before given for forming the plural:—'*gizu* = sharpness,' becomes either '*gizule* = sharp' or '*gizuge* = blunt,' literally, 'sharpness possessing, or, possessing not': from '*nuki* = water,' we get the form '*nukile maram* = the well contains water,' or, '*nukegi maram* = the well is dry': '*danagi* = blind,' literally means, 'eye possessing not': as a further example, I may give, '*ipikai ajirge wap'ina badale mapeip* = the shameless woman eats this sore-producing fish'" [II. p. 301].

A few adjectives are formed by the addition of *thung*, meaning "like, the same as." Macgillivray gave the example, *gariga thung* = like the sun, or, as bright as daylight. No examples of this are found in the Gospel.

Colours.—Macgillivray noted that:—"There are two forms of each adjective denoting colour, except grey and white. Thus, 'black' is rendered either '*kubi-kubi-thung*' or, '*kubi-kubi tha*

gamule,' both meaning 'like,' or, 'the colour of' the charcoal procured from '*kubi-kubi*' = touchwood.' 'Blue, green, and red' are denoted by compounds, signifying resemblance to 'deep water, a leaf, and blood,' respectively" [II. 303].

None of these forms are found in the Gospel, where "white" is *gamul* or *gamulönga*; "red, purple," *kulukal*; "green," *maludönga*.

In Haddon's MSS., however, there is a series of colour names from Tud, similar to those of Macgillivray, but with *da* instead of *tha*. These names are :—

Red, *kulka-da-gŏmŏla.*	Yellow, *dewa-da-gŏmŏla.*
White, *kobi-kobi-gŏmŏla.*	Blue, *malu-da-gŏmŏla.*
Black, *kaibro-do-gŏmŏla.*	Green, *eldra-da-gŏmŏla.*

There are numerous compound adjectives, e.g. *köikutalnga*, long, high; lit., possessing big ends; *köiridanga*, hard; lit., very bony. Macgillivray gives the examples *wati-ngarare*, lame, bad-footed; *wati-ganule*, stinking, bad smelling; *wati-mitäle*, bad tasted; *wati-kaurare*, bad-eared, deaf, &c.

3. Comparison is made by two positive statements, or by a periphrasis.

Example: *Magina modobia Sodoma a Gomora senabi tonar balbaitridan senabi lagal*, a little punishment Sodom and Gomorrah (in) time of rectifying (than) those cities; *matangadagido ngi muia utizö nabi igililenga a nginu getö paunapa patan a ukasukusukö, kalmel genapa taean, senabi mui usimoiging*, worthy (better) thou enter into life and thy two hands cut off (than to be) thrown with them into Gehenna, into unquenchable fire.

Likeness is expressed by *ngöde or ngada*, or in adjectival form, *ngadalgna*.

Example: *ngöde puinge*, like trees; *keda ngadalnga sinapi köusa*, (it is) like a mustard seed; *ngalpa Augadan baselaia mi ngadalnga minapa?* we make God's kingdom like what?

4. A superlative is expressed by means of the word *adapudiz*; lit., coming out beyond.

Example: *nga adapudiz?* who is greatest? *durai nia adapudiz*, the chief seats; *wara salli aiginga adapudiz sebalbi söbia*, have not any law beyond these two laws; *Augadau kazi adapudiz*, Son of God most high; *mina köiza adapudiz senabi pui mura*, real great things beyond all trees.

Kōi is used as a prefix to intensify the meaning of an adjective, as *kōisigal*, very far; *kōimapunga*, very difficult. Macgillivray gives the example, *ke'kamanale*, very warm.—[II. 303].

5. The peculiar adjectival expressions noticed in Miriam are found also in the Saibai Gospel. *Zagi, zaginga*, poor; lit., nothing, not having a thing; *zapu*, rich; lit., mother of things; *zapulaig*, a rich person; *kasa-kupal*, naked; lit., bare-bellied.

§ V.—*Verbs.*

1. Many nouns and adjectives may be used in their simplest forms as verbs, e.g. *noi mai*, he weeps; *ngi mina*, you are true. Where verbal roots have been found in the vocabularies, they invariably end in a vowel: *ngurapai*, teaching; *mulai*, speaking; *pōlai*, cutting.

2. VERBAL FORMS.

(*a*) *Causative.*—There seems to be no definite way of expressing the causative. In many cases it is shown by a suffix *pa*, which is the same as that forming the dative case of a noun, and the same formation as that found in Miriam, where the causative in *em* is also the dative suffix. (See Miriam Grammar, p. 536 of Part I.). Macgillivray regarded the suffix *pa* in Muralug as the ending for the present tense of the verb; and in Haddon's MSS. it is also found as a present tense ending. As used in the Saibai Gospel *pa* expresses an infinitive rather than a present tense, and is very often used with another verb.

A very common way of expressing a causative is by the use of the verb *mepa*, to do, or make, the tenses of which (*mizi*, *mani*), as given in the vocabularies, often form verbs from nouns.

Example: *Launga-mani*, to rebuke, make nothing of; *ubi*, *ubin*, a want; *ubin-mepa*, to wish, want; *adapa*, out; *adapa-mani*, to put out; *ngapa*, hither, come hither; *ngapa-mani*, make come hither, *i.e.* bring; *mina-man*, to measure, span, make a mark; *mari-man*, to pine, become a spirit, &c. Other verbs are used in a similar way. (See Verbal Prefixes.)

(*b*) *Negative.*—The negative verb is formed by affixing *igi* or *iginga* to the root. This is analogous to the formation of negative adjectives from nouns, and the verb usually has a participial or adjectival meaning.

Example: *Tana kapuakasi ginga*, they do not believe, or they are unbelieving; *mui usimoiginga*, the fires are not quenched, or they do not quench the fires; *ngita getötridaiginga*, you have not read; *ngita araiginga*, you do not flee.

In some cases a negative is formed by means of the adverb *launga*.

(*c*) *Interrogative.*—The words *nga* and *mi* and their cases, *ngadö*, *mipa*, *mingu*, introduce an interrogative sentence. (See Pronouns and Adverbs.)

In many cases *midö*, what, is found instead of *mi*. *Midö ngi mangiz?* hast thou come? *Midö mata ngadogidö nidizi kapu pawa ina sabath?* is it right to do good deeds on the sabbath?

Sometimes the interrogative sentence does not differ in form from the affirmative. *Ngita getötritraiginga?* Have you not read?

(*d*) *Quotations.*—These are introduced by *keda* (Miriam, *kega*).

Example: *Mura iamuliz keda, noi umanga*, all said, he is dead; *noi walmizin keda, Iesuae Davitan Kazi, ngona sibuwanan*, he cried out, O Jesu, David's son, pity me; *noi iapupoibiz nubepa keda, ngi wara iman?* he asked him, do you see anything?

(*e*) *Substantive verb.*—There is no substantive verb, though in Sharon's vocabulary *inö*, *ina*, *noi*, *ita*, and *nu* are all given as equivalents for "is." These words have already been shown as demonstratives, § II. A few examples of sentences without verbs may be given here.

Example:—*Nginu nelnga?* thy name (is) who? *kain ngurupai mingadalnga ina?* new teaching like-what (is) this? *ngau nel Legeona, ita ngöi koima*, my name (is) Legion, these we (are) many; *ngai inö Keriso*, I here (am) Christ.

The meaning of the English "to be," in compounds, is often expressed by a circumlocution.

Example: *köigorsar mabaeg kulai taiz, a lako wagel taiz*, many men that are (lit. occupy) first place, again (or next time) are last; *ngau zagetö launga poiban*, it is not mine (not my work) to give.

3. Moods and Tenses.

In the various vocabularies of the Saibai (with the single exception of Macgillivray's valuable Muralug (Kowrarega) list, there is a great want of exactness in the meanings given to the verbs. For example, the verbs 'give,' 'drink,' and 'eat' appear in the five principal lists as follows:—

Macgillivray, ...	*piboipa,*	*wanipa,*	*purteipa.*
MacGregor, ...	*paibanö,*	*wanin,*	*pourtanö.*
Macfarlane, ...	*poiban,*	*wani,*	*purtan.*
Stone, ...	*paiban,*	*wanika,*	*prutika.*
Sharon, ...	*poibaipa,*	*wanis,*	*purutan.*

Macgillivray alone assigns any definite meaning to the words given (the forms in *pa* being given as present tense). An examination of the Gospel translation does not make the subject much clearer, even after a careful comparison with the Lifu version used by the translator. In Lifu, verbs undergo no change of form to express time or mood, all variations in meaning being expressed by separate words or particles; and hence, no doubt, the Lifu translator's difficulty in using the Saibai affixes. The compilers of the vocabularies seem to have taken the words as given in the Gospel in a general sense, and with no attempt to discriminate their meaning. That the discrimination is difficult, appears from the remarks of Macgillivray, whose notice of the verb is the only one in which an endeavour has been made to ensure accuracy. For this reason it is here given in full. He says [II., p. 307]:—

"After tabulating 100 Kowrarega verbs in all the different forms in which they had occurred to me, I yet failed in arriving at a knowledge of their mode of formation, owing to the deficiency of data on one hand, and the presence of some apparently defective and irregular verbs on the other. Still, some of the results are worth recording. Leaving out the consideration of the irregular verbs, I can speak with certainty of only two moods, the indicative and the subjunctive, of the present and the past (probably really further divisible) tenses of the former, and the present of the latter. As an example I may give the verb 'to strike,' of which the root is assumed to be '*matum* = a stroke.'

Indicative	present,	*nudu ngatu matumeipa*	= I am striking him.
,,	perfect,	,, ,, *matumina*	= I struck him.
,,	future,	,, ,, *matumeipakai*	= I shall strike him.
Imperative	present,	,, *ngidu matumur*	= strike him.

"Assuming a root to each, I find 94 of the verbs under examination to agree in having the present tense of the indicative terminating in *pa*: of these, 70 end in *eipa*,[1] 14 in *ipa*, 6 in *epa*, and 1 in *aipa*.

[1] Misprinted *aipa* in the original.

"The perfect tense (setting aside some inexplicable irregularities) exhibits a great variety of terminations, for the formation of which no rule can yet be given: these are *an*, *ana*, *ani*; *in*, *ina*, *eina*; *em*, *ema*; *eima*, *eiun*; and *un*.

"The future tense alone is perfectly regular; it is simply formed by adding *kai* to the present.

"The present tense of the imperative mood in those verbs having the present of the indicative ending in *ipa*, terminates (with one exception in *i*) in *ir*: in the others the terminations of this tense are *ur* (the most frequent); *ar* (the next in order of frequency), *ara*, *ari*; *ada*, *eada*; *e*, *eio*, *eir*, *erur*; and *o*.

"After all I am inclined to suppose that the Kowrarega verb, although apparently complicated, is of simple construction; and that its various modifications are caused by the mere addition to its root of various particles, the exact meaning of which (with one exception) is yet unknown. That exception is the particle *aige* or *ge*, the mode of employment of which is shown by the following examples:—

Waowp' yinu ngai purteip purteipaige = I am not eating your fish.
,, ,, ,, *purteiunaige* = I did not eat your fish.
,, ,, ,, *purteipakaige* = I shall not eat your fish.
,, ,, ,, *nanu ngi purtaige* = Don't eat his fish.

"A few examples may be given in illustration of the preceding remarks:—

English.	Present.	Past.	Future.	Imperative.
Eat, .	*purteipa*,	*purteiun*,	*purteipakai*,	*purtar*.
Bite, .	*mapeipa*,	*mapana*,	*mapeipakai*,	*mapur*.
Take away, .	*meipa*,	*mani*,	*meipakai*,	*mari*.
Tell, .	*mulepa*,	*mulem*,	*mulepakai*,	*muleada*.
Lie down, .	*yuneipa*,	*yunum*,	*yuneipakai*,	*yunur*.
Leave behind,	*yuneipa*,	*yunem*,	*ynneipakai*,	*yunur*.
Shoot, .	*uteipa*,	*utun*,	*uteipakai*,	*utur*.
Enter, .	*uteipa*,	*utema*,	*uteipakai*,	*uterur*."

We now proceed to discuss the expression of moods and tenses as found in the Gospel, reference being made to the foregoing notice by

Macgillivray, and to the Lifu Testament of 1873, from which the Saibai version was made.

(1.) *Mood*:—

(*a*) *Imperative.*—The verbal root is sometimes used indefinitely as an imperative. *Ngapanagi*! behold! look here!

Only one instance is found in the Gospel of the suffix *-r* given by Macgillivray as imperative. *Ngi gedö pagaear*, stretch out thy hand.

The word with the ordinary (tense) ending is used in the imperative. *Kadaitarizo*, stand up! *Iman senabi ngitamun körngaizinga*, take heed what ye hear! (lit. find your hearings); *Ngalpa meamaipa wadōkapa*, let us go to the other side! *Iagiasin, gudö mumi!* be quiet, be still! *Ngi adapadan*! you come out! *Ngaeapa mulix*, tell me! The plural imperative has in some cases an affix *ziu*, *miu*. *Ngita karengemiziu*, hear ye! *ngapanagemiu*, look ye! *Maginaközingu getōwanemiu ngapa ngaeapa*, let little children come to me! A dual ending *mōriu* is seen in, *Ngipel uzarmōriu*, go ye two! from *uzar*, go.

A prohibitive is expressed by the verbal root with the negative affix. *Wara mabaegöpa mulaigi*, tell not any man! Usually, however, the word *maigi* (from *mai*, the root of *mepa*, *mani*, to do, and *igi*) is used to prohibit an action. *Maigi puru*, do not steal! *Maigi akan*, do not fear! *Maigi karengemin*, do not listen!

The Lifu imperative expressed by *loi e*, it is good that, is literally translated by the Saibai *kapuza*, good thing. *Kapuza ngita ladun*, go ye! (Lifu, *loi e trojë nyipunie*); *kapuza ngi ngapa uzar*, you come here! Cf. Miriam *debele* (Pt. I., p. 537). 'Must' or 'ought' is translated, as in Miriam, by the noun meaning 'work,' *zagetö* (hand thing) with the possessive pronoun. *Ngau zagetö miëi nidiz?* what must I do? *Nginu zagetö Iehovalpa ngōnanumani*, thou must remember Jehovah.

(*b*) *Infinitive.*—There is no special sign for the infinitive, one verb simply following the other. *Kuikaiman koima maumizin*, began to preach much; *ngai ngapa mangizö turan mabaeg balebaiginga launga*, I came not here to call upright men.

(*c*) *Desiderative.*—A wish is expressed by the word *ubin-mepa*, to make a wish, to want. *Miëi ngipel ubin-mepa ngai ngipelpa poiban?* What do you two want me to give you? *Wara lago muia utiz, a ubin-mepa ita durai mabaegal nubepa imaiginga*, went inside another house and wanted men not to find him.

(*d*) *Potential.*—Ability to perform an action is expressed by the word *ngulaig*, knowing, or to know how. *Nga ngulaig getöwaniz senabi watri pawa?* who can forgive sins? In Mk. xiv. 8, *ngulaig* is used with a possessive pronoun. *Na muasin nidizi nanu ngulaig*, she has done her ability, *i.e.* what she could. The negative of *ngulaig* is *korawaig*. *Tana korawaig aipurutan*, they could not eat; *noi korawaig usar*, he could not go; *ngai korawaig*, I don't know.

(*e*) *Subjunctive and Conditional.*—There seems no definite way of expressing a dependent sentence, and there is no change of form in the verb. The words used to introduce a conditional sentence are *sike*, if; *ba*, if; *toma*, *tuma*, lest; *tomaka*, perhaps. The adverb *wa*, yes, is often used between the protasis and the apodosis: the dependent sentence is frequently in the future.

Ex. *Sike ngalpa iamuliz daparngu, kai noi mulepa, Mipa ngita nubepa töradöiginga?* if we say, from heaven, he will say, Why have you not received him? *Ngalpa usar senabi amadan lagö, ngai maumizineka siei*, we go to the next place, that I may (will) preach there; *sike kauralaig, wa, noi karengemin*, if (he) possesses ears, then he hears; *ba ngatö tanamulpa waean, tana umuwalepa siei iabugudanu*, if I send them away, they (will) faint there on the way; *ngai ngibia kalmel umanga, wa, ngai nginungu gudötödaiginga*, if I die with thee, I do not deny thee; *sike kuikulunga taupain töraiginga senabi göiga sena, wara mabaeg igiliginga*, if the Lord had not shortened those days, any man (would) not live; *tuma noi tarai mangizö a iman ngita a mata utui*, lest he come quick and find you still asleep; *noi iautumiz nongo niaikazi magina gulpa noinö ugan, inö mabaeg köigörsar, toma tana nubepa kai garönanamiz*, He ordered His disciples for a little boat to await Him, the men (were) many, lest they should crowd Him; *Nga mabaeg kain waina paieudan senabi au döpuza, tomaka papalamizö kae senabi döbu buiu*, what man pours new wine into an old thing, perhaps the old bottle will burst.

(2.) *Tense*:—

Three apparent tense endings appear in the Gospel, but the distinction between them is difficult to make out. These endings are *pa*, *iz*, and *n*.

(*a*) *Pa.*—This ending was given by Macgillivray for the present tense (see p. 145), but is of comparatively rare occurrence in the Gospel. Even when used it seems to express an infinitive of purpose

rather than a present tense, usually translating the Lifu infinitive sign *troa*. In the following examples there seems to be no indication of present time. *Getöwani mabaegöpa danalpataipa apö*, left men to look after the garden; *iautumizö senabi pasau danalpötai mabaeg, poipimipa*, ordered the man looking after the door, to watch (Lifu *troa hmekën*); *na ngulaig nabepa nidaipa*, she knew what was done to her; *aipa baropudäipa*, to buy food (Lifu, *troa itö xene*). This use of the suffix *pa* expresses the same idea as in the dative case of nouns.

In a few cases, the Gospel shows *pa* as a present tense ending. *Nongo niai kazi nubia pusipa*, His disciples follow Him; *mi za ngai ieudepa?* what do I ask? *ngita danalpataipa a poipiam, a töitupagiz*, take ye heed, watch and pray. In these three examples the Lifu has in the first case the past, in the second the future, and in the third an imperative without tense sign.

(*b*) *Iz, izö, izi.*—It is by no means certain that these suffixes are identical in meaning. Macgillivray refers to the ending *izzi* only once. In a note on the words *söka, sali*, he says:—"These two words appear to have the same meaning, but are used differently: '*sok'atchin* = *salimizzi*,' and both express 'having been sick.'" [II., 304.]

As used in the Gospel *z, zö, zi* usually express the present tense of an intransitive verb, and correspond to the particle *a* in the Lifu version. *Ngai ngibepa mulizö*, I say to thee (Lifu, *ini a qaja koi eö*); *noi iautumiz nongo niai kazi*, He orders His disciples; *noi kadaip waliz padapa*, he climbs up a mountain. The suffixes *iz, izö, izi*, do not always express a present tense. In many cases they are used to translate the Lifu past sign *hna*. *Durai siëi putizi iabugudanu*, some there fell on the path: *göiga palgizö*, the sun rose (Lifu, *hna hojë la jö*); *noi kadaitarizi*, he arose; *Iesu nubepa nagiz*, Jesus looked at him.

(*c*) *-n, -ni.*—The ending *n* was given by Macgillivray for the perfect tense. As used in the Gospel, it usually expresses the simple past of a transitive verb, and translates the Lifu past participle, *hna*, or the present perfect, *hë, ha*. *Noi minarpalan senabi tusi*, he wrote that book; *Tana nubepa angan setabi magina köziel*, they brought to Him little children; *noi iman senabi suke köisigal nisalnga*, he saw a fig-tree afar off having leaves.

Just as the suffixes *iz, izö, izi* are sometimes found expressing past tense, so also *n* is frequently used in the Gospels in the present tense. *Ngai iman mabaeg uzar*, I see men walking.

(*d*) There is another, and probably more correct view which may be taken of these three endings *pa*, *iz*, *n*. It is to regard them as suffixes of a similar nature to the Melanesian transitive endings, and indefinite in tense. Then *pa* simply states the action generally, *iz* states it as performed indefinitely, *n* as a transitive action performed upon some object. Compare *imaipa*, *imizi*, and *iman* in the following phrases:—*Noi danal wani mabaegpa* imaipa, he looked round to see the man (Lifu, *anganyidëti a goe goeëne* troa xajawatine *la ate*[1]; *tana* imizi *a* iman *senabi kula*, they looked and saw the stone (Lifu, *angate* a goeëne *ame* hna öhne *la ete*). Cf. also, *Iesu noino getö ielpan, a nubepa kadai taran, a noi kadai tariz*, Jesus took him by the hand and raised him, and he arose.

(*e*) *Perfect Tense.*

The verb *muasin*, meaning 'to finish,' is used with other verbs to express the completion of an action. *Ngita muasin karengemin*, ye have heard; *na muasin nidizi nanu ngulaig*, she has done what she could (lit., her ability); *noi muasin tanamulpa wasan*, when he had sent; *noi muasin iamuliz*, as soon as he had spoken.

The meaning of the present perfect is often expressed by the adjectival ending *-nga*. *Kazi umanga*, the child is dead (Lifu, *meci hë la nekö*).

(*f*) *Pluperfect.*

A kind of pluperfect is expressed by the termination *izinga*, which forms a verbal noun, and is used with the possessive pronoun. *Tanamun imaizinga*, things they had seen, lit., their things seen. (See Nouns, § III., 1.)

(*g*) *Future.*

This tense is shown by the word *kai* (*ka*, *kae*), usually following the verb, but sometimes preceding. It is used with the root, or with the endings *pa*, *iz*, *n*. Cf. (*d*) above. *Mangi kai senabi tonare*, a time will come; *ngita iman kai mabaegau kazi*, ye shall see the son of man; *kai noi mulepa*, he will say; *ngita kai töridiz*, ye shall receive. Macgillivray also gives examples. See p. 146. This *kai* must be distinguished from the *kai* or *ki* of emphasis. The verb *ladun*, to go, is also used to express the future. *Ngalpa ladun iman*, we are going to see. The Lifu future particle *tro* is also the verb 'to go.'

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[1] This phrase is in the ceremonious language used to chiefs in Lifu.

(*h*) *Continuance.*

The word *mata* is used to translate the Lifu *pete kö*, while, and expresses the continuance of an action. *Tana mata wakaiasimoin*, while they mourned; *noidöka mata utuipa*, as he sowed; *tana mata iagiasin*, they were silent. Magillivray has *gul mata pongeipa* = the canoe is still under sail [II., 305].

(*i*) *Repetition.*

The word *lakö* expresses repetition. *Iesu lakö mangiz au Kapernauma*, Jesus again came to Capernaum; *ngai lakö ubinmepa danalpataipa*, I wish to open eyes again; *ngai lakö wönigi*, I will not drink again.

(*j*) *Emphasis.*

A verb or verbal phrase is rendered emphatic by the word *kai*, at the end of the sentence: *Noi mamu kai*, he *was* well. This is probably the same as the (M), Kowrarega *ki* of which Macgillivray remarks (II., 312):—"The meaning of this is, to a certain extent, doubtful; however, it enforces an affirmation; Ex. *ina muggi'ki* = this is *very* little: it is frequently used after pronouns; *arri ki kabapakai* = we *shall* go to the dance."

The Lifu *emphatic* particle *hi* is translated by *wa* = yes, verily. *Karengemin, wa karengemin a wakain-tamamoiginga*, hear, yes hear, and not understand. In Lifu: *troa deng, a denge hi, ngo tha trotrohnine pe.*

4. Number.

A verb is used with a singular, dual or plural pronoun with the simple endings. *Ngai iamuliz*, I say; *palae iamuliz*, they two say; *tana iamuliz*, they say.

In some cases, especially when the pronoun or other method of marking number is not used, a syllable is inserted between the root and the verbal ending. The following examples are found in the Gospel:—

Dual.—*Nongo ukasar kaura paleman*, his two ears were opened; *ngipel sipalsei kai mangeman*, you two shall come; *palae uzarman*, two went. The usual forms of the verbs are *palan*, *mangiz*, and *uzar*, but the examples present some difficulty, and do not agree; the infixes being *em*, *ma*. The verbs *mangiz* and *uzar*, come and go, do not elsewhere appear with the suffix *n*.

Plural.—The plural appears to be distinguished by the infix *möi*, *mai*, or *mi*. In Sharon's vocabulary, *patamöin* is given as the plural

of *patan*, to cut. Examples from the Gospel are :—*Ngalpa mulemipa*, we say; *mura demoni nubepa ieudemipa*, all the demons besought him; *ngau ia idimöiginga*, my words shall not pass away; *durai patan puitamal a iabugudanu a poidamoin*, some cut branches, and spread on the road; *mura mudö garoweidamoin*, all the crowd assembled.

Many words which naturally have a plural agent are rarely found except in the plural form, such as, *garoweidamoin*, to assemble together; *gudamoin*, to discuss.

5. Verbal Prefixes.

The Saibai verb is rarely found in the Gospels or vocabularies (except in Macgillivray's) in a simple form. It mostly appears with a prefix, which, to some extent, serves the purpose of an adverb and defines the meaning. It is in some cases difficult to ascertain the exact meaning of the verb itself, or of its connection with the idea expressed by the prefix, but the meanings of the latter are in most cases clear. The prefixes may be conveniently classified as corporal, nominal, modal, and directive.

(1.) *Corporal Prefixes.*—These are names of parts of the body.

1. *Bag*, cheek; *bag-taean*, to promise.
2. *Dan*, *dana*, eye; *dan-paliz*, to open the eyes, be awake (eye-divide); *danal-pataipa*, to watch (put out eyes); *dan-taean*, to exhort (roll or throw eyes).
3. *Gamu*, body; *gamu-diwapa*, dance; *gamu-doidanu*, tired (body in wilderness); *gamuia-mataman*, to murder; *gamutariz*, to touch.
4. *Get*, *geta*, *getö*, hand; *getö-nitun*, to point; *getö-pagaean*, to apprehend; *getö-waean*, to loose, let go; *getö-pudeipa*, to scrape hands, etc.
5. *Gud*, *guda*, *gudö*, mouth; *guda-moin*, to discuss; *guda-palamiz*, to overflow; *guda-purutan*, to be insolent (eat-mouth); *gudö-nitun*, to advise; *gudö-tapaman*, to kiss.
6. *Kakura*, *kuku*, foot, toes; *kakura-pataean*, to step across; *kukuna-mapeipa*, to kick.
7. *kuikö*, *kuiku*, head; *kuiku-iman*, to begin (find head); *kuikö-patan*, to behead; *kuikö-taean*, to nod, etc.
8. *Madu*, flesh; *madu-paman*, to start, be afraid.
9. *Ngöna*, breath, heart; *ngöna-pudiz*, to take a long breath, to rest; *ngonanu-mani*, to remember (bring into the heart).

10. *Paru*, forehead, face; *paru-idun*, to deceive.
11. *Sibu*, liver; *sibu-wanan*, to pity (perhaps "cheer up") (put a liver); *sibö-papalamiz*, to doubt (liver flies away). The liver is probably regarded as the seat of courage.
12. *Tabai*, shoulder; *tabal-uradiz*, to carry on the shoulders.

(2.) *Nominal prefixes* are names of objects, and are not so easily distinguished as the preceding.

1. *Barö*, grass; *barö-pudaipa*, to buy (i.e. barter, put down on the grass); cf. *za-pudamoin*, to sell (put down a thing).
2. *Bupö*, the bush; *bup-ariz*, to flee (run to bush).
3. *Butu*, sand; *butu-pataipa*, to cleanse; *butu-paliz*, to shake off.
4. *Guba*, wind; *gubal-puian*, to blow.
5. *Gud*, opening (see mouth); *gud-paliz*, to bud.
6. *Ia*, *iadu*, word; *ia-muliz*, to say; *iadu-palgan*, to confess; *iadu-turizö*, to inform; *ia-kaman*, to inform; *ia-utumizi*, to command. Most verbs expressing the saying of something take this prefix.
7. *Sup*, covering; *sup-nuran*, to cover (*nuran*, to wrap).

(3.) *Modal prefixes*.—These mostly describe the manner of the action expressed by the verb, and might almost be classed with the directives.

1. *Dada*, in the middle, between; *dada-mangiz*, to meet (come in middle).
2. *Garö*, together; *garö-guimani*, to shake, quiver, earthquake; *garö-pataman*, to collect food; *garö-taean*, to press; *garö-nanamiz*, to crowd; *garö-weidamoin*, to assemble.
3. *Kidö*, over; *kidö-taean*, to turn over, overthrow.
4. *Kun*, back; *kunia-tidiz*, to return.
5. *Pa*, motion; *pa-töridiz*, to carry along; *pa-ielpan*, to lead along; *pa-ieudiz*, to pour; *pa-waliz*, to land, climb on shore; *pa-taean*, to throw; *pa-silamiz*, to move against, to attack; *pa-nudiz*, to press, rub along, etc. Nearly all verbs of motion begin with *pa*, and it is also used with the directives. Cf. also the dative suffix and verbal ending *pa*.
6. *Pal*, double (cf. dual demons); *tu-pal-taan*, to fold (*tu* = English *two*).

(4.) *Directives.*—These are often combined with the prefix of motion, *pa*.

1. *Ngapa*, hither (cf. prons. *nga-i*, I; *nga*, who?); *ngapa-uzar*, come hither; *ngapa-mani*, bring hither; *ngapa-nagemiu*, look hither. Macgillivray has the following note upon ngapa:—

   "Ngāpa.—This is a word which, from the variety of its modes of application, long puzzled me. Careful examination of sentences in which it occurred led to the following results:—1st. It may be used as an independent word to denote motion towards the speaker, the pronoun which would otherwise be required being omitted. Example: '*adur* = go out,' but '*ngap' adur* = come out (towards the speaker),' '*lak' ngapa* = to come again, to return.' 2nd. It is also used as a postfix to denote motion towards the object to which it is joined. Example: '*laga' p'* (*ngapa*) *aigewel* = come to the hut,' '*mue' pa teir* = throw it into the fire.' 3rd. It is used in a third sense. Example: '*wawpi' pa* = to go fishing,' '*kaba 'pa* = to go to a dance. 4th. It is often used as an equivalent to 'give me,' the hand being held out at the same time. Example: '*ngapa* = let it come to me.'" [II., 308].

   The first of these uses is the directive; the second the dative; the third the verbal suffix.

2. *Ada*, *adapa*, thither, outward; *ada-taen*, *adapa-taean*, to throw away; *ada-pudiz*, high (to be out beyond something else); *adapuidan*, to eject; *adapa-mani*, to take away; *adapakadaman*, to peel, to tear away. Cf. Mir. *ade*, outside.

3. *Kadai*, *kadaipa*, up; *kadai-tariz*, to stand up; *kadai-nagiz*, to look up; *kadaipa-waliz*, to climb up. Cf. Mir. *kotor*, up, sky.

4. *Apa*, down; *apa taean*, to throw down; *apa-tanu*, to sit down; *apa-sin*, to stoop; *apa-nian*, to sit on the ground.

5. *Mulpa*, down; *mulpa-pŏgamiz*, to descend.

6. *Nguro*, out; *nguro-taean*, to keep out; *nguro-weidan*, to cast out.
7. *Siga*, afar; *siga-taean*, to convulse (throw afar).

There are apparently many other similar verbal prefixes of which the meanings are not clearly made out. See words beginning with *toi* (*toitu-pagaipa*, *garo-toi-taean*), *wakai*, *ngoro*, and *giu* in the Saibai Vocabulary.

6. VERBAL SUFFIXES.

These do not appear so prominently as in Miriam. Besides those already noted (*pa*, *iz*, *n*, *izinga*, etc.) there are found the endings *ilamiz*, *mani*, *mizin*, *asin*, *ae*, and *ai*.

1. *Ilamiz* has a verbal form and means 'against'; *muliz-ilamiz*, to accuse (speak against); *pa-zilamiz*, to attack (move against); *ngurs-ilamiz*, to wink (prob. from *nurse*. See Voc.).
2. *Mani* means give, bring, take, etc., and has been already noted. Cf. *meipa*.
3. *Mizin* appears to be connected in meaning with *mani* and and *meipa*.
4. *Asin* means to be with, and has a plural, *asimoin*, and negatives, *asiginga*, and *asigi*.
5. *Ae*. *Ngoi korawaigae*, we cannot tell, we don't know! This is almost equivalent to an exclamation. Cf. the vocative suffix *ae*.
6. *Ai*. *Ba poibanai*, for it shall be given. Mark, iv. 25.

9. Peculiar phrases used to supply the place of verbs are:— *Mai adan*, weep, put out tears; *mai mani*, make tears, mourn; *ipidadö pugan*, blaspheme; *igili palan*, to save life; *walmizin*, to shout, make a coo-ey; *apa niain ngönamani*, to meditate, sit on ground to think; *tanamun mari adapa katö palagizö akan*, they were amazed, their spirit flew out of (their) neck with fear; *tana mekenmepa mabaeg tanamulpa amaean*, they love salutations, they like men to crawl to them.

§ VI.—*Adverbs*.

1. INTERROGATIVE.—Interrogative adverbs are formed by means of the cases of *miei*, *midö* (see Interrog. Prons. p. 131) or by prefixing *mi* to nouns.

(*a*) *Place.*—*Milagnu?* (in what place) where? *Nagö*, *naga* (s), *nager* (M), where? *Nagö mi ngadalnga?* where (is) the likeness? *Nalaga?* (what place) where? *nalaga a ngöi butupatan?* where (is) thy wish that we prepare? *Nalagazi?* (from what place) whence? *Nalagazi pa adan senabi zagetö ina nubia?* from whence has this man these things?

(*b*) *Time.*—*Migöiga?* (what day) when? *Mi tonar?* (what sign) when?[1] *Mi tonar mangiz senabi pawa ina? mi tonar minaipataman senabi mura zasei?* When shall these doings come? what sign shows all these things? *Namoit?* when? (Macfarlane). How long? is translated by *kurusipa midö?* till what? or by *mibuta? Ngai ngitamulpa baminadan kurusipa midö?* How long shall I suffer you? *Mibuta nubepa mangiz?* How long since (it) came to him?

(*c*) *Cause.*—*Mipa?* (for what) why? *Mipa nidiz sena?* why do that? *Mipa ngita nukunukö pöibiz?* why make ye this ado? *Mingu?* (through what) why? *Mingu ngita ngöna nutan?* why do you tempt me? *Minguzö?* (through what things) why? *Minguzö senabi maikuikö a luman inabi tonar?* why does this generation seek a sign?

(*d*) *Manner.*—*Midö-paru?* (what appearance) how? *Midö paru ngöi korawaig nubepa nguroweidan?* How (was it) we could not cast him out? *Mingadalnga?* (what like) how? *Ngalpa mi ngadalnga nubepa minaman?* we shall measure it how?

(*e*) *Number.*—*Mida kubi?* how many? (*lit.* what many) is given by Macgillivray, but no examples of its use is found in the Gospel, which has *midö* only. *Areto midö siëi ngitamunia?* how many loaves have you? *Iana midö gudia-ieudiz?* how many baskets full?

2. PLACE.—*Inö*, *ina*, here; *sei*, *siei*, there; *sena*, *senao*, that there; *bradar* (B) here; *mata launga*, not here; *gurugui*, around; *worgi*, *wörögi*, on, upon; *mulpa*, *malupa* (M), downward, below, lit. to sea; *nakäreipa* (M), upward, above; *kulaikulai*, before; *kapitaig* (M), a long way off; *amadan*, near.

Adverbs denoting positions are mostly formed from nouns by the suffix *l* or *lö*. Cf. Adjectives. *Adal*, on the outside, away, off; *apal*, *apalö*, on the ground, down, under, below; *dadal*, in the middle;

[1] The natives regulate their occupations during the various seasons of the year by the constellations, which are thus signs (Saib. *tonar*; Mir. *mek*) of the seasons. See vol. II., p. 548.

matadödalö (B), inland; *gimal*, on the top, over, above; *sigal*, at a distance; *wagel*, last. *Sigal* is declined in dat. and abl. *sigapa*, to a distance; *sigasi*, from a distance. The word *kö*, meaning the place close by, is declined like *sigal*: *kopa*, to a little distance; *kosi*, from a little distance; *köu*, of a little distance.

Example: *Iesu Köpa amadan usar*, Jesus went forward a little; *noi kosi gurugui usar*, he had gone a little further on; *kösi kain göiga palagizö*, a little after new sun rose; *ita köu nitaman*, sit hereabouts. Macgillivray has *kåreki*, hereabouts. *Siĕi* is also declined; *siĕiki*, from there.

Emphasis is given to adverbs of place and time by prefixing *köi* (*kai*, *kei*) great, very; *köi-sigal*, very far, etc. Examples occur in all the authorities, and Macgillivray uses also *kara* with the same meaning; *karamalupa*, a long way down, far below.

3. TIME.—*Nabi*, now, at present; *nabi-göiga*, to-day; *mata-döbura*, immediately; *kaibö*, *kaibu*, now, soon, to-day; *kulu kubö*, anywhile; *tumatuma*, by-and-by, presently; *batainga*, in the morning; *bangal*, to-morrow; *matabangal* (M), a week or so hence; *ngul*, *ngulö*, yesterday; *war-gaiga* (B) (other day) yesterday; *kul*, two or three days ago; *matakul*, a week or two ago; *körĕkida*, a long time ago; *muasin*, after; *lakö*, again; *mata*, continually, still, yet; *ngaru*, ever, always.

4. MANNER.—*Köi*, *kai*, *kei*, very; *lakö*, more; *mata*, only; *mamu*, carefully; *samidö*, really; *tomaka*, perhaps; *purke* (M), well, etc.; *kasa*, just, only (cf. *kusaig* and Mir. *no*); *kasa-kupal*, just a body, naked; *kasa-tabu*, only a snake, *i.e.*, a harmless one; *kasa wanan*, forsake, leave alone; *nainonibe*, separately.

5. Some adverbs have a reduplicated form. *Ikalikal*, gladly; *moilmoil*, sadly; *kulaikulai*, before; *tumatuma*, by-and-by.

§ VII.—*Postpositions and Local Nouns.*

These take the place of the English prepositions.

1. The postpositions used as suffixes to nouns and pronouns are: *u*, *n*, *mun*, of; *pa*, *lpa*, *mulpa*, to, for; *ngu*, *mulngu*, from through, concerning; *nu*, at, on, in; *dö*, *du*, by, by means of; *ia*, *bia*, *munia*, with; *le*, possessed of; *igi*, *gi*, without.

The use of these words has been fully illustrated in the sections on pronouns, nouns, and adjectives.

Ki, to, for; and *si*, from, are only added to demonstratives, and then form adverbs or conjunctions.

Macfarlane gives *mani* as a suffix, meaning by, but there are no examples of its use.

2. Some nouns are used with postpositions to express relations of place. These are *paru*, forehead or face; *ada*, outside; *mui*, inside; *buadö*, side; *gima*, top; *kalö*, back.

They appear as *parunu*, before; *paruia*, opposite to, contrary; *adapa*, out of; *muinu*, inside, within; *muia*, into; *buadia*, beside; *malu buadia*, by the sea-side; *gimainu*, over, above; *gimaingu*, from above; *gimia*, on the top; *kalanu*, after, behind; *kalapa*, to, behind.

The word *mai* with the genitive case is the equivalent of the Miriam *kes*, 'sake.' *Herodian mai*, for the sake of Herodias; *kedazöu mai*, for the sake of that thing; *mepaiangu mai*, for the world's sake; *ngau mai*, my sake.

The verb *asimpa*, *asin*; plural *asimoin*, neg. *asigi* is used with the meaning 'be with.'

With, referring to persons, is translated by a noun *kalmel*. *Wara ngau kalmel ai purutan*, one eating food with me, lit. one my companion eating food; *ngai ngibia kalmel umanga*, I die with thee.

A few other words are given as prepositions in the vocabulary, but they are mostly compounds such as *nungu*, from (from it).

§ VIII.—*Conjunctions.*

1. *A*, and, also, but; *ba*, for, and if; *mata*, but, for; *sike*, if; *tuma*, till, until; *tomaka*, perhaps; *kurusipa*, until.

Macgillivray gives *ia*, and, with an example: *Uleip' Aburdia, Salalallia, Wagelia, Mania* = *Aburde* and *Salalle* and *Wagel* and *Manu* are approaching.—[II., 306.] Cf. this *ia* with the ergative suffix.

2. The word *keda*, like, thus, with the noun *zö*, thing, is declined to form causal conjunctions. *Kedazöu*, for; *kedazöpa*, therefore; *kedazingu*, *kedazöngu*, *kedazinguzö*, therefore, because.

§ IX.—*Exclamations.*

1. *Ua! wa!* yea! yes! *Misai!* yes! *Samido!* yes! *Wagar!* yes! *Guire*! (M) no! *Ae!* ah! (of sorrow). *Au! akamiz!* oh! (of surprise). *Igur!* poor thing!

2. The salutations are: *Iawa!* good-bye! farewell! *Sangopa!* good morning! The latter is perhaps a corruption of the Samoan *alofa*.

Similar expressions are: *Kami!* (M) *kömi!* (N) my dear! I say! look here! (said by a female to a male). *Kawki!* (M) *kiki!* (N) with the same meaning are said by a male to a female. *Beägi!* (M) a call to a blind person. *Maige!* (M) *maigi!* (S. B) *wan-nur!* (M) don't! *Sina! china!* (M) stop! enough! *Tuma!* (B) wait a bit! *Ais!* come!

3. The vocatives *ama!* and *baba!* have been noticed in the section on nouns.

§ X.—*Syntax*.

The following are the chief syntactical rules:—

1. The Subject precedes the verb. *Göiga putizö*, the sun sets.

2. The Direct Object follows the subject and precedes the verb. *Tana arakato putran*, they cut a hole.

3. The Indirect Object often follows the verb. *Iesu iamulis tanamulpa*.

4. Adjectives and possessives precede the noun. *Kain dumawaku*, new garment; *ngau kazi*, my son; *lagöu kala*, house's back; *nginu watri pawa*, thy evil deeds.

5. The adverb precedes the verb. *Iesu mamu iman*, Jesus carefully looked; *tana muasin putra*, after they had cut.

6. *Government of Verbs*.—There is a great variety in the cases used with verbs, depending apparently upon the nature of the action expressed by the verb. An examination of the commonest words in the Gospel show them governing cases as follows:—

(*a*) With *accusative* or no case ending, when the verb expresses the direct action of one thing upon another. Examples—baptise, behold, cast out, cleanse, confess, cut, do, drink, eat, forgive, make, pour, preach, prepare, send, take.

(*b*) With *dative* when action of one thing influences or is directed towards another. Examples—ask, believe, betray, blaspheme, call, come to, convulse, fear (for), give, have dealings with, inform, kneel to, know, lead, minister to, pity, punish, rebuke, say, see, seek, send, show, teach, tell, tempt, testify, throng, watch.

(*c*) With *ablative* when the action arises from the influence of another. Examples—fear (arising from something), issue.

(*d*) With *ergative*, when subject and object are both affected in the same way. Examples—enter (*utis*, Macgillivray *uteipa*, approach), follow (go when something else goes), touch (two things come in contact.

§ XI.—*Numerals and Measures.*

1. The Numeral system of the Western tribe of Torres Straits islanders, collectively called in this Study the Saibai, has been very fully discussed in the Ethnography. (See Journ. Anthropological Institute, vol. xix., 1890, pp. 303–306.) What follows is mainly a reprint of that notice, with some additions from the Gospel.

Throughout the Western islands of Torres Straits there were practically but two numerals, *urapun* and *ŏkŏsā*, which are, respectively, one and two. Three is *okosa urapon*, four is *okosa okosa*, five is *okosa okosa urapon*, six is *okosa okosa okosa*, beyond that they usually say *ras*, or "a lot."

There is a decided tendency to count by twos or couples.

The following Table shows the variations in the numerals as they appear in the various vocabularies:—

1. *wărăpúne*, . . . 2. *quassur*, ... 3. *ŭquassur-wărăpune*, . .	Kowrarega (*sic*). Macgillivray [II. p. 301].
1. *warabon*, ... 2. *augosa*, ... 3. *warabon-augosa*, . . .	The Western tribe as a whole. Wyatt Gill [p. 225].
1. *warapon*, ... 2. *ukesar*, ... 3. *ukesar-warapon*, . . .	Masig. D'Albertis [II. p. 387].
1. *urapon*, ... 2. *kusa*, ... 3. *kusa urapun*, . . .	Masig. Stone [p. 252].
1. *wara, urapon*, . . . 2. *uka*, ...	Saibai. Sharon MS.

1. *urapon*, ... 2. *ukasar*, ... 3. *uka-modobigal*, . . . 4. *ukasar-ukasar*, . . .	Saibai. Macfarlane MS.
1. *wara, urapon*, . . . 2. *ukasar*, ... 3. *ukamodobigal*, . . . 4. *uka-uka*, ...	Gospel.
1. *ŏrŏpun, orapuni, urapun*, . 2. *ōkŏsā*, ... 3. *ōkŏsā ŏrŏpun*, . . .	Moa, Badu, Mabuiag, Nagir, and Tud. [A.C.H.].
1. *wurapu*, ... 2. *okasara*, ... 3. *okasara-wurapu*, . . .	Tud. Curr [I. p. 684.]
1. *ūrāpūni, ōrāpuni*, . . 2. *ukŏsa, ōkŏsā*, . . . 3. *bādāgĭli*, ...	Muralug. [A.C.H.].

One hand, *urapuni-gĕtāl*, probably stood for five objects, and two hands, *okosa getal*, for ten, but it is doubtful whether ten would be recognised as being composed of five twos, *i.e.*, *okosa, okosa, okosa, okosa, okosa*. A Badu and a Moa man both gave *wāgetāl wāgĕtāl* for ten.

In Muralug *bādāgĭli* suggests that they originally counted up to three, probably through Australian influence.[1] The word *badagili* is a derivative from *bagadi*, perhaps meaning all or both (the other numbers). *Badaginga*, another derivative from the same root, is used in the Gospel for "whole, entire."[2]

[1] The following are some examples of Australian numerals:—

West Australia,	1. *gain*.	2. *gudjal*.	3. *warkrang*.
Gudang (Macgillivray),	1. *epĭāmana*.	2. *elābaiu*.	3. *dama*.
Cape York (W. W. Gill),	1. *pirman*.	2. *labai*.	3. *ilanamina*.
Raffles Bay,	1. *loca*.	2. *orica*.	3. *orongarie*.
Moreton Bay,	1. *kamarah*.	2. *bulla*.	3. *mudyan*.
Lake Macquarie,	1. *wakol*.	2. *buloara*.	3. *ngoro*.

[2] *Badagi* itself may be a derivative from a root *böda*, which appears in *bödadogam*, the left (*i.e.*, the other) side. *Bodagi* would thus mean "not the others" (*i.e.*, first and second fingers) or the remaining three.

There was also obtained at Muralug *ina nabīgĕt* (this here hand), or *nabīget* (this hand) for five; *nabiget nabiget* for ten; *nabikoku* (this foot), for fifteen; and *nabikoku nabikoku* for twenty. *Nabiget* can hardly be said to be the name of the number five, but that there were as many of the objects referred to as there are fingers on one hand.[1] In the same island *maura* was given for 100 (probably *mura* "all"), and *kaigasa* for 1000 (*köi görsar*, a great many), but these are not true numerals.

The words *wara*, *uka* which appear in the Saibai MS. and in the Gospel for one, two, are probably the root forms of the numerals. *Wara* is also used for other, a certain, in the Gospels, and *uka* appears as a verb, *ukamoin*, to double. *Uka-modobigal*, used for three in the Gospel is also formed from *uka*. *Modobigal* means "the fellow which makes up (three)" from the verb *modobia*, to answer, pay, *i.e.* give in return, and the noun *igal*. Cf. Daubai *modobe*, to make up.

The demonstratives *ino* (singular), *ipăl* (dual), and *ita* (plural), are sometimes used with one, two, and three. One Muralug informant gave 1 = *ino urapuni* (this one), 2 = *ipal ukosa* (those two), 3 = *ita badagili* (those not the other two), 4 = *ipal ukosa ukosa*, 5 = *ipal ukosa ino urapuni*, and 6 = *ipal ukosa ukosa ukosa* or *wara badagili*.

Counting is usually performed on the fingers, beginning with the little finger of the left hand. This was probably the original method. There was also a system of counting on the body by commencing at the little finger of the left hand, *kotodimura*, then following on with the fourth finger, *kotodimura gorngozinga* (or *guruzinga*); middle finger, *il get*; index finger, *klak-nĕtŏi-get* (spear-throwing finger); thumb, *kabaget* (paddle-finger); wrist, *perta* or *tiap*; elbow joint, *kudu*; shoulder, *zugu kwoik*; left nipple, *susu madu* (breast-flesh); sternum, *kosa*, *dadir*; right nipple, *susu madu*, and ending with the little finger of the right hand. (These names were obtained at Mabuiag; those used in Tud and Muralug are somewhat different).[2] This gives nineteen enumerations, of which eleven to nineteen are merely inverse

[1] These are suggestive of the Lifu vigesimal system, and are, perhaps, imitations of it.

[2] Macfarlane's MS. gives a similar list for Saibai:—1. *urapon*; 2. *wardadim* (other finger); 3. *dadadim* (middle finger); 4. *kalakönitu*, spear thrower; 5. *kuikudimö*, chief finger or thumb; 6. *perta*, wrist; 7. *kudu* (elbow); 8. *zugu*, shoulder; 9. *susu*, breast; 10. *kabu*, back; 12. *wadegam zugu*, shoulder on the other side.

repetitions of one to nine. The names are simply those of parts of the body themselves, and are not numerals.[1]

An unexplained word *laelö* is used with numerals in Mk. vi. 7. See Vocabulary.

This system could only have been used as an aid to counting, like using a knotted string, and not as a series of actual numbers. In a question of trade a man would remember how far along his person a former number of articles extended, and by beginning again on the left little finger he could recover the actual number.

Only the old men are acquainted with this method of enumeration, and it is now superseded by the European system.

All the numerals now in use are borrowed from the English. Simple arithmetic is taught in the Mission Schools, and the ciphers are all introduced.

Seasons.

"There was no division of the year into months or days, and the years were never counted. Time was usually reckoned by suns or days, and by moons or months."—(*Ethnography*, p. 303.)

The year *wato* is divided into two seasons—*aibu*, the period of the south-east winds, and *kuki*, the season of the north-west monsoons. Macgillivray gives *aibow*, summer or dry season; *kuki*, winter or rainy season. With regard to other seasons there is some uncertainty, and, perhaps, a confusion of names. Macfarlane gives *kuki*, spring; and *buti*, autumn, as divisions of the year *sasiwaur*. In the Gospel (Mark, xiii. 18) winter is translated *aigi tonar*, foodless time; summer (Mark, xiii. 28) is *dökal natisö*; and harvest, *burugomel* (Mark, iv. 29). Macgillivray gives also *malgui* (*i.e.* growing) as spring and autumn, and

[1] A similar system of counting is found in parts of New Guinea. Chalmers' "Pioneering in New Guinea," p. 75, gives fourteen numerals of Kaevakuku Elema as follows:—1. *harohapo*, small finger of left hand; 2. *orahoka*, next finger; 3. *irohiho*, middle finger; 4. *hari*, fore finger; 5. *hue*, thumb; 6. *ukövs*, wrist; 7. *para*, fore arm; 8. *ari*, elbow; 9. *kae*, upper arm; 10. *hero*, shoulder; 11. *korave*, neck; 12. *avaku*, ear; 13. *ubuhai*, eye; 14. *uvira*, nose. It is then continued down the right side to the small finger of the right hand. Also in describing the Orokolo (Elema country) counting he says:—"In counting they begin with the small finger on the left hand and go up to the arm—by the neck, ear, eye, and nose—to the other side, then down the right arm, ending at the small finger thereof." ("Work and Adventure," p. 163).

sulangi, the turtling season. "*Surlangi*, the season when the turtle is 'fast' (*i.e.* copulating); this, at Cape York, usually extends from about the middle of October until the end of November, but the limits are not constant."—(*Ethnography*, p. 350.)

The times at which certain constellations (*Dorgai*) appeared were noted, and these became the *tonar* or signs for particular dances or occupations. Thus in Tud, the star *Kerherki*, which appeared when food was ripe, became the sign for the dancing of the *kap garig* (see *Ethnography*, pp. 303, 365). The *Dorgai waralaig* was one of the constellations of *Aibu* (*Legends*, i., p. 31), while the *Dorgai kukilaig*, and *Bu*, the Pleiades, appeared at the dancing season in *kuki* (*l. c.*, p. 31).

Points of the Compass.

As in Miriam, these only approximately correspond to the European terms, and are named from the prevailing winds. The authorities often differ, and some of the words are probably descriptive of the position of the speaker rather than true names. We have found the following words :—

N., *Naigai*, *Nangap*, *Naida-dögam* (north side). This is probably the Miriam *Naiger*.

N.-W. wind, *Kuki*. Mac Gregor gives *Nukagnabaguba*.

S., *Je* (Mac Gregor) ; (*Pin*)*nangap*, *Zadogam* (Macfarlane).

S.-E. wind, *Waura*, *Aibu*.

E., *Palagiz* (rising), *Poipetegam* (look out side), *Waradogam* (other side). Macfarlane also gives *Pinapai*.

E. wind, *Waura*.

W., *Gaiga pudizo* (sun sets), *Wagedegam* (behind side), *Kukidögam* (side of west wind).

W. wind, *Kuki*. (Mac Gregor).

IX.—SPECIMENS OF THE SAIBAI LANGUAGE.

1. THE HEALING OF THE LEPER.

(*Mark*, i. 40–45.)

40. Wara lepera nubepa uzar, a mulpa patritiz nubepa a iamuliz keda, nginanga sike ubinemepa, ngulaig ngöna butupatan göugan aima.

41. Iesu nubepa wakaeasin, a noi getö pagaean a nubia nidiz, a iamuliz keda, Ngai ubimepa ngi mamu.

42. Noi muasin iamuliz mata döbura adapamizin nongo lepera, a mina ngadalenga.

43. Iesu koima gudö wadan nubepa a waean nubepa, a iamuliz nubepa keda.

44. Wara mabaegöpa mulaigi, wa uzar, ngibepa iakman wakaia uiamai mabaeg, a poiban Mose nanga ia utumiz tana mulpa tonar tritran ngi wara ngadalngange.

45. A noi uzar, kuikaiman koima maumizin, a garouian senabi ia, keda zingo noi kora waig uzar senabi lagö; noi iawaig siëi mabagi lago, tana nainanope uzar nubepa siëiki.

2. THE SOWER.

(*Mark*, iv. 3–9.)

3. Ngita karengemiziu, ngapanagemiu, ngapa uzar senabi wara mabaeg utun a utun.

4. A noidö ka mata utuipa, durai siëi putizi iabugudanu, ngapa mangizö urui palgizö a purutamoin.

5. Durai gimal mukö putizi ina magina baradar, mata döbura malegui-adan, pepe baradarangu.

6. A goiga palgizö, baradar koamasin, a kainga, wa ramoginga.

7. Durai tutizi pui patralai dadal, kadaipa malegui adan pui pratralinge a apapa ngurötaeamoin, a köusagimael.

8. Durai putizi ina mina baradaranu, a tarötaiz, a sirisiri, a köusalenga; a köusa aidainga thörte nainonop a sikiste, a wan handed.

9. Noi iamuliz tana mulpa keda, mi mabaeg kaura aidainga, noi karengemin.

3. The Wicked Husbandmen.

(*Mark*, xii. 1–9.)

1. Iesu lakö kuika iman tana mulpa iamuliz ia mina matangadagid, keda, wara mabaeg vineu Apö söwagai a papagan, apö kuikö mamu nanitan, a möidan senabi lago apau danal patai lagö, getö wani mabaegöpa danal pataipa apö, a uzar köisigapa.

2. A aingu tonar, noi waean wara niai kazi tana mulpa siwagöiu mabaegöpa, a durai vine kousa mani.

3. Tana ki nubepa gasaman, a nubepa mataman, a nguro weidan, a noi iaginga.

4. Noi waean wara niai kazi tana mulpa; tana nubepa kula taean kuikupa papōlamöipa a nubepa ngurö weidan getö langaizinga.

5. Noi waean wara, tana nubepa uma mataman; a durai koigörsar, a durai mataman a durai uma mataman.

6. Mata siëi nubia nöidail kazi, noidö noino waean tana mulpa, a iamuliz keda, Tana ngau kazipa akan.

7. Tana söwakaiu mabaeg ia uman sei, keda, Butapa ina ngalpa nubepa mataman, a nongo za ngalpan zapul.

8. Tana nubepa gasaman, a uma mataman, a vine apangu adataean.

9. Kuikulumai vine apangu miëi mani? a noi mangizo tana mulpa söwaki lagöpa mataman, a vineu ap; wara mabaeg pange turan.

4. The Last Passover, Betrayal and Trial of Christ.

(*Mark*, xiv. 1–72.)

1. Muasin ukasar goiga ina paseka, senabi areto levene ginga; tanamun köi görköziu wakaea uiamoin, a tana minarpölai mabaeg tana luman wara iabugud noinö gasaman senabi paruidan, a noinö uma matan.

2. Tana iamuliz, keda, Maigi senabi ta mura mabaegongu silamailai.

3. Iesu Bethanianu apatanori senabi Simonan lagö ina lepera; noi apatanori a aipurutan, wara ipökazi böi mangizö binibini laig alabasa muinu muro mina za; na muasin papalamöin senabi binibin alapasa, na paieudan nongo kuikunu.

4. Durai mabaeg tabukiri, a iamuliz, keda, mipa kasa pa ieudan senabi muro?

5. Sike muasin, zabutamöin sena, ukamodobigal magina ina handede, senabi denari modobia zagi mabaegöpa poiban tana nabepa tabukiri.

6. Iesu iamuliz, keda, maigi nabepa tabukiri; mipa ngita nabepa ipi dadö mani? kapu za getö ina nadö ngaeapa mani.

7. Mata sena ngita munia zagi mabaeg, ngita ngulaigö nidizi kapu zagetö tana mulpa senabi tonar ngita ubin meamaipa; ngai ngaru niaiginga ngita munia, inö.

8. Na muasin nidizi nanu ngulaig; na sulan ngau gamunu a zamiak ngaeapa maramatöiaipa.

9. Mina ngai ngita mulpa iamuliz, keda, senabi lagö mura ina apal maumizin ina evangelia sena iadu palgan senabi nanu zagetö, nabepa ngöna numani.

10. Wara tuelv kuiku mabaeg nel, Iuda Isakariota, a uzar köi garekaziu wakaeuiamoin, noidö noino gudaran tana mulpa.

11. Tana karengemin, tana ikatiaipa a tana nubepa puzariz a mani nubepa poiban. Noi iabu luman a Iesun gudaran.

12. Senabi kulai göiga ina areto levene ginga, senabi tonar urui mataman a pasekapa wakaia uiamoin, nongö niai kazi iamuliz nubepa keda, Nginu ubin mai nalaga, a ngöi butupatan a ngi purutan senabi paseka?

13. Noi waean ukasar nongo niai kazi, a iamuliz pala mulpa, keda, ngipel uzar senabi lagapa, a ngipel dadamangiz wara mabaigia a buiu ngukulnga patra uradiz; a nubepa peltaean;

14. Senau noi muia utiz, iamuliz lagau lagöpa, Ngurupai mabaeg, keda, nalagi azazi mabaeg, senabi ngai pasekanu purutan a ngau nia kazi?

15. Noidö sesitaman ngipelpa wara köi ngabad gimal, poidamoizinga a butupataizinga, kapuza moidemin, ngoi mulpa siei.

16. Senabi nongo niai kazi palae uzareman, a mangeman senabi lagönu, a iman keda noi nanga midö pala mulpa iamuliz, palae butupatan senabi paseka.

17. A kutrapa, Iesu mangizö kalmel tuelv mabaeg.

18. Tana apa nitaman aipa purutaipa, Iesu iamuliz, keda, Mina ngai ngita mulpa iamuliz, keda wara ngau kalmel ai purutan ngona gudaran.

19. Tana kuika iman watri wakasin, a iananab nubepa iamuliz, keda, Midö ngai? wara keda, midö ngai?

20. Iesu modobia iamuliz tana mulpa keda, Wara tana mun tuelv mabaegangu, senabi mabaeg ngau kalmel ai pagan senabi peleit.

21. Kapuza senabi mabaegöu kazi keda ngadalnga minarpalan nubepa, ngau kupalenga senabi mabaeg inö mabaegau kazi gudaran, sike kazi mani aiginga wa noi mamu.

22. Tana purutan, Iesu areto mani, a eso, a maginu mani, a tana mulpa poiban, a iamuliz, keda, mani, purutan, senabi ngau gamu.

23. Noi mani senabi ngukiai, a eso, a tana mulpa poiban, a tana mura waniman.

24. Iesu iamuliz tana mulpa, keda, Ngau kuluka ina kain ia utumiz paieudan tana mulpa mura mabaegöpa.

25. Mina ngai ngita mulpa iamuliz, keda, ngai lakö wönigi senabi vinau köusangu kurusipa inabi göiga ngai lakö nungu ngu wanizö kain senabi Augadau baselaia.

26. Tana muasin na poidan wara na. Tana uzar senabi padö Elaio.

27. Iesu iamuliz tana mulpa, keda, Ngita mura getöwanizö ngaunguzö nabi kubi kubilö ina, muasin minar palan, keda, Ngai mataman mamoe danal patai mabaeg, a mura mamoe nainönöb uzar.

28. Muasin, a ngai lakö igililenga, ngai kulai uzar ngita mun parungu Galilaiapa, nigita kai wagel.

29. Petelu iamuliz nubepa, keda, Sike tana mura nginungu getö waniz, ngai kai launga.

30. Iesu iamuliz nubepa, keda, Mina ngai ngibepa muliz, ngi ukamodobigal ngaungu gudö tadiz, nabi kubilu ina, a kalakala ukasar poibaiginga.

31. Noi koi ma iamuliz, keda, Ngai ngibia kalmel umanga, wa, ngai nginungu gudö tödaiginga, Mata keda tana mun mura ia.

32. Tana mangizo wara lago, Gethesemane nel, Iesu iamuliz nongo niai kazi, keda, Apatanorömoiu ina, kurusipa inö muasin ngai töitu pagizö.

33. Noi Petelulpa angan, a Iakobo, a Ioane a kuika iman körkak koamasin, a mazarpagan.

34. Noi iamuliz tana mulpa, keda, ngau mari mina köi kikiri, keda kikiri umö nanga midö ; ita köu nitamau a poipiam.

35. Iesu köpa amadan uzar, a baradaranu apatanoriz, a töitu pagiz, a nubia mangaginga senabi haua siëi nubia sike ngulaig.

36. Iesu iamuliz, keda, Aba, Baba, ngi ngulaig zanguzangu mura ngaungu mani senabi binibini ina, ngau ubilnga lakö maigi, kapuza nginu ubilnga.

37. Noi mangizö a iman tana a utui; noi iamuliz Petelu, keda, Simonae, ngi utui? ngi magao ginga poipiam senabi haua urapon.

38. Ngita poipiam, a töitu pagiz ngita muia utaiginga senabi nutan; mari magao, a gamu gögainga.

39. Iesu lakö uzar töitu pagizö, a iamuliz, senabi urapu ia.

40. Noi lakö kunia tridizö a imiz tana a lakö utui, tana mun puruka maitui, tana körawaig nubepa modöbia iamuliz.

41. Iesun uka modobilgal mangail a tana mulpa iamuliz keda, ngita mun utui, ngöna pudizö; keda mangizö ina haua; ngapanagemiu, Mabaegau kazi muasin kobegad karumpalan setabi mura mabaegau watri getö.

42. Kadaini tamau, ngalpaldui pa; ngapanagemiu, amadan senabi mabaegan ngona gudaran.

43. Noi közi muliz, Iuda mata döbura mangizo wara kalmel tana munia tuelv mabaeg, noi kalmel mura mabaeg koi kuiai turik a gabagaba patra uradiz, tana mulngu wakai uiamoi mabaegangu, a minar polai mabaeg, a durai moroigal.

44. Noido senabi mabaegan noinö gudaran, tana mulpa iamuliz, keda, senabi mabaeg ngatö gudö tapaman, wa, sena noi, noinö gasaman, a köima kai puzaromoin.

45. Noi mangizö, noi mata döbura Iesulpa uzariz, a iamuliz keda, Rabi, Rabi, a noinö gudö tapaman.

46. Tana nubepa getö pagaean, a noinö gasaman.

47. Wara tana murungu kadaitariz, a kuiai torik dökopingu pardan, a mata man senabi mabaegau wakaia uiamoi lagau niai kazi, a nono kaura patan.

48. Iesu iamuliz tana mulpa, keda, Midö, ngita ngaeapa boie uzar keda puru mabaeg nanga midö, kuiai torik a gabagaba patra uladiz ngaeapa mataman?

49. Ngai ngita munia wakai uiaipa puzipu senabi dana ngoro ngomai lagopa, a ngita ngöna gasamoiginga, mata ngadagid senabi ia minarpalan.

50. Tana mura nubepa getö wanemin, a arizö.

51. Wara kawa-kuig nubia asin, nongo gamu abizö dumawagu sak wali lino abaiginga; durai kawakun noino gasaman.

52. Noi getö waniz senabi sake wali lino a kasa kupal arizö.

53. Tana Iesun gasaman tana mulpa köi görközipa wakai uiamon mabaeg, a tana minar pölai mabaeg.

54. Petelu nubia wagel gabudan ulaipa senabi ngabadö, köigörköziu wakai umai lagö, a kalemel niai kazi apata nori, a muipa koamapa kalmel niai közia apatanori.

55. Tana durai köigörköziu wakaia uiamöin, tana ia balbaigi palan, a nubepa wakain pagaipa a noinö mataman; a imaiginga.

56. Köi görsar mabaeg nubepa ngölkai iamuliz, a tana nainonobe iamuliz.

57. Durai kadaini taman nubepa ngalakai ia taean, keda.

58. Ngöi karengemin noi iamuliz, keda, Ngatö idimoin senabi lagö getau moidai zinga, seta uka modöbilgal göigöil, ngatö wara möidan getan moidaiginga.

59. Tana urapon iabu ia mulaiginga.

60. Tana mun wakai uiai mabaeg dadal kadaitariz, a Iesulpa iapupoibizi, keda, Ngi modobia iamulaigia? tana mun ia miëi ngibepa imulizilamizo?

61. Iesu ia mulaiginga, a modobia maiginga. A tana mun köigarkazi wakaia uiamoin a lakö nubepa iapupoibizi, keda iamuliz, nubepa, ngi Keriso, ngi Mamal tötiu kazi?

62. Iesu keda, Ngai inö; ngita iman kai Mabaegan kazi getadögam apa tanori senabi Parpar, kalmel daparau zia uzar.

63. Senabi köi görköziu wakai uiamoin noidö nongo dumawaku paiele gamöin, a iamuliz, keda, Mipa wara ia imulizilamizö;

64. Ngita muasin karengemin Augada gegetö pugan; ngita mun wakai tama main midö? Tana mura kuduman keda mata ngadagid noi umanga.

65. Durai mabaeg kuika iman noino mosan sulupan, a nongo paru supu nuran, getan nubepa mataman, a iamuliz nubepa keda, pa perofeta lakö, tana niai kazi noinö mataman.

66. Petelu apatanori ngabadönu muinu, wara ngawakazi uzar köigörköziu waia uiamai lagau niai kazi.

67. Nadö Petelun iman muingu köamapa, na nubepa nagizö a iamuliz, keda, Ngi senabi mabaeg kalmel Iesu Nazaretalaig?

68. Petelu gudö tadiz, a iamuliz, keda, Ngai körawaig, ngatö mamu ngurupaiginga senabi nginu ia, Noi adapadan ioungapa, a kalakala poibiz.

69. Lakö noinö iman senabi ngawakazi niai kazi, a kuika iman iamuliz kadain sei mabaegöpa, keda, Wara tana mun inö.

70. Petelu lakö gudo tadizö, soabaginga a senabi kadai tarai mabaeg a iamuliz Petelu, keda, sike mina ngi wara tana mun mabaeg ngi Galilailaig, ngita mun urapon iangukudu.

71. Petelu kuika iman bögailbögail gudö tadiz, keda, ngai köra-waig nabi mabaeg ina ngita mulpa iamuliz.

72. A kalakala ukasare pöibizi, Petelu ngonanu mani senabi Iesun ia nubepa mulizö, keda ngi uka modobilgal ngaungu gudö tadizö, a ukasar launga, kalakala poibiz, noi ngona numani, a noi mai.

X.—SAIBAI AND ENGLISH VOCABULARY.

This Vocabulary, of about 3400 words, is compiled chiefly from the MSS. of Sharon (MS. 8), Macfarlane (MS. 6), and Haddon (MS. 3), but all the words contained in other vocabularies have been added. Words unmarked may be regarded as the common language, and are found in the Translation (16) and in Macfarlane's list (MS. 6); in other cases the exact locality in which the word was obtained is marked as follows:—

S. Saibai, from Sharon (MS. 8).

M. Muralug, or Prince of Wales Is., from Jukes (Port Lihou) (1), Macgillivray (Kowrarega), (2), and Haddon (MS. 3).

B. Boigu, or Talbot Is., and Saibai, from MacGregor (23).

MG. Masig, or Yorke Is., from Jukes (Masseed), (1), Stone (Machik), (10), and D'Albertis (9).

T. Tud, or Warrior's Is., from Curr (15).

MB. Mabuiag, or Jervis Is., from Savage (MS. 7).

The lists collected by one of us, contain words from all of the above, as well as from (N.) Nagir, or Mount Ernest, Moa, or Banks' Island, and Bădu, or Mulgrave Island.

The cases of nouns and verbal expressions are given with the simplest form in square brackets. The numbers in curved brackets refer to the pages in the Ethnography ("Journ. Anthrop. Inst." xix. 1890), where the object mentioned is described.

Saibai-English Vocabulary.

A, *conj.* and, also; but.
aba (M), *pron. dual,* us two.
abaiginga, *a.* not covered, uncovered, bare, naked.
abal, *n.* a single fruit of the pandanus.
aban (M), *pron.* our (inclusive dual).
abeipa (M), *v.* to cover over, overshadow. [aban].
abizö, *n.* a covering.
abul = abal; abul-dan' (lit. pandanus-eye), the kernel of the pandanus fruit.
ada, *ad.* out.
adabada-mitalnga (B), *n.* brackish water.
adabadu (B), *n.* salt water.
adabu (M), *n.* salt water.
adadadagainga (B), *v.* to dine.
adadögam, *n.* outside. [adadogapa.]
adakado, *ad.* through.
adal, *ad.* out.
adan, *a.* open, opened; *v.* from adeipa.
adapa, *ad.* out, away, off.
adapadan, *a.* past; *v.* to issue.
adapagan, *v.* to come out; adapagan gulngu, come out from the ship. Mark, vi. 54.
adapakadaman, *v.* to peel.
adapamani, *v.* to remove, to take away.
adapamizin, *v.* to depart, to go out, to escape.
adapa-taean, *v.* to throw away.
adapa-tamoin, *v.* to escape.
adapa-waean, *v.* to disperse.
ada-pudiz, adaputiz, *a.* superior, highest; *ad.* beyond.
ada-puidan, *v.* to eject, extend.
ada-taean, *v.* to leave, to abandon, to reject.
adautubaba (B), *n.* a wing feather. Cf. baba.
ada-wakaimizin, *v.* to spite.
adeipa (M), *v.* to go out; to perforate, cf. adan.
adi (M), *n.* a mythical person turned into a rock. (Legends, i. 181). Cf. Miriam Ad.

adi (B), *n.* a story or tale.
adia (?), Mark, iv. 11.
adigila (T), adizela (T), *n.* a wig.
adö (B), *n.* a goose.
adoăma (M), *n.* an uncle; mother's brother. Cf. tati, keuba tati, waduam.
adŭdziolai (T), *n.* a wig. Cf. adigila.
adzar (M), *a.* forbidden as food.
ae, *exclam.* ah! Mark, xv. 29.
aewidan,
aga, *n.* an axe; aga-turik, aga-turi, an iron axe.
agaleg (M), *n.* an eagle.
agu (Mb), *n.* a platform on which the shells of turtle were preserved (406).
agu (M), *n.* a cairn of stones; the back of a turtle.
ai, *n.* food. [aidu, aipa, aingu.]
aibo (M), aibu, *n.* the south-east monsoon; name of the dry season.
aidai, *v.* to have, to possess.
aidainga, *a.* having, possessing.
aideigan = aidainga. Mark, iv. 25 (or ? = not to have).
aidu, *n.* food. Cf. ai.
aidu-poiban, *v.* to give food, to feed.
aie, *v. imperat.* come! (from a place near).
aie-wêl (M), *v. imperat.* come here!
aigar (?), nanu aigar barpudan, all her living. Mark, xii. 44.
aigi, *suffix* to adjectives implying negation.
aigiasina (B), ripe.
aigina, *suffix*, none, not; tanamunia aiaigina, they have no food. Mark, vi. 36.
aiginga, aigingö, *a.* not having.
aigi-taean, *v.* to spend, to finish (?). Mark, v. 26; xii. 22.
aigi-tonar (S), *n.* famine time; winter.
aikeka (M), *pron.* myself.
aima (?), ngöna butupatan göugan aima, make me clean. Mark, i. 40.
aimaipi, aimipa, aimeipa, aimöipa, *v.* to make, to do, to build. [aiman.]
aimiz, *v.* to commit adultery. Mark, x. 19; to destroy, Mark, iii. 6.

aimiz-gudaran, *v.* to betray.
aimizi, *v.* to betray. Mark, iii. 19; to kill, Mark, vi. 19.
ai-purutan, *v.* to eat food; *n.* a feast.
ai-za, *n.* food.
ajir (M), *n.* shame.
ajiran (M), *a.* ashamed.
aju, (M), *n.* a shell, (*Cypræa*).
aka, *n.* fear.
akagi, *v.* not to fear; do not fear.
akaginga, *a.* not fearing.
akamaiza, *n.* a shield. Probably a made-up word. Cf. aka, mai, za.
akamiz, *exclam.* oh!
akanö, *v.* to fear.
akir (MB), a word used in connection with the "small name" (406).
akul, akulö, *n.* the clam shell, (*Cyraena*); used as a spoon; also used as a knife in making masks and other objects.
akur (M), *n.* the intestines.
ălae, *n.* alai (M), husband.
alakö, *n.* a rent, a tear. Mark, ii. 21.
alaliz, *v.* to puzzle.
alase, *n.* salt. A Greek word introduced *viâ* Lifu. [alasiu, alasenu.]
alasilgal, *n.* salt persons; Mark, ix. 50. kapu za ngita alasilgal, good thing (if) ye (are) salt people. Eng. = have salt in yourselves.
alasue,
albei (M), *pron.* we two.
albeine (M), *pron.* our (exclus. dual).
albinipa (M), *pron.* for us two (exclus. dual).
ălgadi (M), *n.* the barb of the javelin = (tun).
ălidan (T), *n.* a groin shell used when fighting. Cf. lorda.
alka (M), a spear (333), probably kalak.
alopa (M), *n.* the melon or scoop shell, (*Cymbium*). Cf. alup, salop.
alotö (B), *n.* salt.
alpa (M), *pron.* let us; shall we?
alub,
alup (aluk M), *n.* the melon, bailer, slipper, or scoop shell, (*Cymbium*). Cf. salop.
am = amu.
ăma, *n.* mother; mother's sister. Used only in the vocative. Cf. apu.

amadan, *a.* near.
amaean, *v.* to creep, to crawl.
ămai, *n.* a native oven, often called kŏpamauri. The latter is an introduced term.
amaipa, *v.* to make, create.
amaizö, *v.* to beg.
amal (B), *n.* a cloud, cumulus.
amamu, *ad.* well.
amau (S), mother, = ama.
ame. Cf. amai.
ameipa (M), *v.* to be affected with.
amori (S), *n.* a sail.
amu, *n.* a plaited native rope used with the dugong harpoon.
ana (M), *pron.* me, my.
anaga (M), *ad.* where?
anamu, *a.* hale.
angai-dumawaku, *n.* coat. Mark, vi. 9.
angan-toridiz, *v.* to carry.
angeipa, *v.* to hold, to carry. [angan].
angemina (B), *v.* to swallow.
angizö, anguzö, *v.* to put on (of clothes.) Mark, vi. 9.
anwar (MG), *n.* finger-nail.
aona (M), *n.* the sting ray. Cf. tapi.
ap = apa, apö.
apa, *n.* ground, earth, soil, country; pl. apal. [apau, apapa, apangeu, apia.]
apa, apal, apalö, *ad.* and *prep.* down, under, below.
apa-dökam, *n.* the under side, the bottom (lit. ground side).
apai, *a.* low.
apal, *n.* the bottom; kuikaiman gimal kurusipa apal, from the top to the bottom. Mark, xv. 38.
apalapal (S), *n.* the world (lit. below).
apapui (?), apa, pui. Mark, iv. 32.
apasin, *v.* to stoop.
apataean, *v.* to be cast down, to be offended. Mark, iv. 17.
apatanu (B), apatanor, apatanur, *v.* to sit down. [apatanoriz.]
apatanori, *v.* abide (imperative). Mark, vi. 10.
api, *n.* a fishing net.

api-angai-mabaeg, *n.* fisherman (lit. net-holding-man).

apia (? from apö); ina kai umai apia purutan laulauiu magina kaziu börupudaizing, the dogs under the table eat the children's crumbs. Mark, vii. 28.

apia-iaunano (B), *v.* to lie down.

apiga, *n.* the Malay apple, a *Eugenia.* Cf. List of Introduced Words.

apnu (S), *n.* a village (lit. in country).

apö, *n.* a field, garden, plantation; konau apö, *n.* corn field. Cf. apu.

apopauna, *n.* the hand.

apŏrega, *n.* a bird, the "native companion."

apu, *n.* mother; mother's sister. The common noun. [apupa.] Cf. ama.

arage (M), arake, *a.* silent.

arai (S), *n.* rain, = ari.

araiginga, *v.* not to flee; ngita araiginga, ye flee not. Mark, xiii. 18.

arakato = arkatö.

arang (M), *n.* armpit.

ararăpa (M), *n.* a small bat.

arawi (?), arawi-gul (S), *n.* a ship.

arepa, *v.* to shield.

ari, *n.* a black louse.

ări (M), *pron.* we, us.

ari, *n.* rain.

ărien (M), *pron.* of us, our.

arĭga (M), *n.* a fishing line.

ărinipa (M), *pron.* for us.

ari-pudeipa (M), *v.* to fall; (lit. rain falls).

ari-puilaig (MB), *n.* the rain-man; a sorcerer producing rain (401).

ariŭg (M), *n.* a fishing line.

ariz, arizö, *v.* to flee.

arkatö (B), arakato, *n.* a hole; arakato putran, *v.* to make a hole.

arö, *n.* dawn, daybreak.

arodardö (?), tanamulpa arodardö garö ngalekan mai kapuakösiginga, upbraided them with their unbelief. Mark, xvi. 14.

aröpugiz, *v.* to cry out. Mark, xv. 39.

asarö, *v.* to sneeze.

asigi, *a.* not with. Mark, ii. 19.

asiginga, *a.* not being with, not accompanying or following. Mark, ix. 39.

asima,

asimpa (?), noi gurugui nagepa puruka borbaradö gamu asimpa tanamulpa, he had looked round about on them with anger. Mark, iii. 5.

asin, *v.* to be with; *prep.* with.

asir, *n.* shame.

asiran, *a.* ashamed.

ăta (M), *n.* the belly of a turtle.

atadonga, *a.* broad, wide.

atadrun (S), *n.* native bread.

ătang (M), *a.* flat; (see ăta).

ati, *n.* the octopus. Cf. sugu and arti, Miriam Vocab.

au, particle expressing the locative, used before names of places.

au, *exclam.* oh!

auak (MG), *n.* a woman. (Stone). Cf. awash.

auar, *n.* a claw, = awar.

auei, *n.* paint.

augada, augadö, *n.* God (introduced meaning). Cf. augŭd, Mir. agud. [augadau, augadan, augadapa, augadano, augadal.]

augosa = uka, ukasar, two; warabon augosa, three.

augŭd, *n.* a totem.

auwa, *n.* a mat.

auwai (M), *n.* the pelican, = awai; auwai-kap = awai-kap.

awai (MB), *n.* the pelican; awai-kap, the pelican dance (362).

awar (B), *n.* a claw.

awash (M), *n.* a woman's covering.

awiali,

awidizö, *v.* to honour.

awidö (B), *n.* an oyster.

azar (M), forbidden as food.

azazi (? travelling), azazi-san, *n.* shoe, sandal; azazi-mabaegö, *n.* a guest; nalaga azazi mabaeg, *n.* guest chamber. Mark, xiv. 14; azazi-zana (B), *n.* foot.

azipa (M), *v.* to become.

azirö (B), *a.* ashamed; *v.* to blush; *n.* shame.

aziran, *a.* ashamed.

azugerka (I), *n.* name given by a girl to her sweetheart. Cf. rogaig.

Ba, *conj.*, for, if; ba poibanai, for there shall be given. Mark, iv. 25; ba ngatö tanamulpa waean tanamun lagöpa, if I send them to their houses. Mark, viii. 3.

baba, babö, *n.* father, in vocative only. [babange.]

baba, *n.* a feather; (M), quill of an eagle.

babad, *n.* sister, = babatö or babŭd.

babange; see Grammar, p. 139.

babat, babatö, *n.* sister; (see barabatö); a sister without children (B), *pl.* babatal.

babasum (T), *n.* the eyebrows.

baba-wangu (S), *n.* father.

babŭd, *n.* a man's sister or a woman's brother.

babu-iabu, *n.* a ditch (lit. a stream of the road).

babun, *n.* the tail of a fish.

babur, *n.* a scar.

bada, badö, *n.* an ulcer, a sore.

bada (B), *n.* a shield.

badagĭli (M), three.

badaginga, *a.* whole, entire; nginu korka badaginga, all thy heart. Mark, xii. 30.

badalaiga (B), *n.* the yaws.

badăle, *a.* sore; (M), *a.* sore producing.

badalenga = badăle.

badanga, *a.* on the left, left-hand. Cf. böda-dögam.

badar (M), *n.* the toad fish.

badi,

badöulai pa (?), Iesu nögain mamu badöulai pa, Jesus looked round about. Mark, x. 23.

bag, bagö, *n.* the chin, lower jaw; the cheek.

baga (B), *n.* a duck.

bagabŏgub (M), *n.* a stone headed club.

baga-mina, *n.* a cicatrix on the face (367). Cf. mausa usal.

bagai (?), noino bagai sölman, railed on him. Mark, xv. 29.

bage, *n.* a cloud.

bager, *n.* a long spear.

bag-iata, *n.* whiskers, (lit. cheek-hair).

bag-taean, bagö-taean, *v.* to promise.

bagumö (M), *n.* lightning.

bagur (M), *n.* pus.
bai (S), *n.* grass.
baibuli (B), *n.* an insect.
baidam, baidamö, *n.* a shark; baidam togui, a shark's fin, baidam-sai-togui, a shark's tail.
bai-ib (N, M), *n.* the eyebrows.
baiidun, *n.* a shark, = baidamö.
baili *n.* a basket made of the leaf of the coco-palm = boi.
bait (T, M), *n.* the cuscus (opossum of Cape York), = barit.
balbadö *n.* coast.
balbai, *a.* crooked, bent.
balbaigi, *a.* not bent, straight.
balbaiginga, *a.* = balbaigi.
balbaig-palan, *v.* to put straight, to explain.
balbainga, *a.* crooked, wrong.
balbai-pudiz, *v.* to peep.
balbai-tidan, balbai-tridan, *v.* to make straight.
balbai-tilam, *v.* to bend.
balbai-tridaipa, *v.* to make straight, to rectify.
balö, *n.* breadth.
balopudan, see baröpudaipa.
balpudai (? root of baropudaipa), balpudai-döid, *n.* a market.
balopudan, balpudan, see baropudaipa.
baltariz, *v.* to stand still. Mark, x. 49.
bami-nadan (?), *v.* to put up with; to suffer. Mark, ix. 19.
ban, misprint for bau. Mark, iv. 37.
bangal, *n.* the morrow, the next day, the day before. Mark, xv. 42; (M), two or three days hence.
banitan (?), Pilato köisarköisar banitan sisike noi umanga, Pilate marvelled if he were already dead. Mark, xv. 44.
barabatö (M), *n.* a man's brother or woman's sister. In vocative only.
baradai (S), *n.* earth, soil. Cf. apa, J.
baradar, baradör, *n.* earth, soil, ground. Cf. apa. [baradau, baradöran, baradaranu, bara dorönu, baradarangu.]
baradi, *n.* a stony hill.
bärdö, *n.* thatch.
bări (M), *n.* grass.
baribara (B), *n.* a coconut, used for drinking purposes.

barit (T, M), *n.* the cuscus, = bait.

baröpudaipa, barpudan, balopudan, *v.* to buy; nanu aigar barpudan, her living, i.e., her food buying. Mark, xii. 44.

bărŭder (M), *n.* mud. Cf. baradar.

bataiuga, *n.* the morning; (M) to-morrow.

bau, *n.* the sea; a wave of the sea; bau sik, *n.* waves. Mark, iv. 37.

bau, *n.* a spear.

baua (M), *a.* flat, plain.

bauka (?), mosan bauka weidaman, to foam at the mouth. Mark, ix. 18, 20.

beăgi (M), *exclam.* a call to a blind person.

beara, *n.* the ribs. Cf. bero.

bĕge, *n.* a cloud.

beibăsa, *n.* eyebrow. Cf. babasum.

beidum (M), *n.* a shark, = baidam.

bepa, *suffix*, for.

berai (?), berai-pungaipa *v.* to be easy. Mark, x. 25.

bĕribei kar, *n.* a rope fence.

bero, *n.* the ribs, chest, side of the body. Cf. beara.

bero-pui, *n.* a lath (lit. rib-wood).

bête (M), *n.* drift-wood.

bia, *suffix.*

bidu (M), *n.* the porpoise.

bigu, *n.* a bull roarer with a low and deep note (406).

biia (M), *n.* a bird, the goatsucker.

biiu, *n.* the mangrove. "A gray slimy paste used as food, and procured from a species of mangrove (*Candelia* ?), the sprouts of which, three or four inches long, are first made to undergo a process of baking and steaming—a large heap being laid upon heated stones, and covered over with bark, wet leaves, and sand—after which they are beaten between two stones, and the pulp is scraped out fit for use." Macgillivray, ii. p. 26.

bila (M), *n.* the parrot fish.

binibini (S), *n.* a cup; (B) a soup-plate (?); binibini alabasa, an alabaster box. Mark, xiv. 3.

bipi (?), (S), *n.* the nose.

biraig, *n.* a table.

birgesera. (Ethnography, p. 415).

bisi, *n.* the sago palm; sago.
bis-uab, *n.* mourning armlets and leglets made of *bisi* leaves.
bizar, (M), *n.* the purple yam. Cf. ketai.
boa (M), *n.* the conch shell, = bu.
bobata (M) *n.* a grandfather.
boboam (M), *n.* a shell, (*Ovulum*).
boboŭm (T, N), a shell (*Ovulum*) = buboam.
böbu, *n.* a rill, a stream, = bŭbŭ.
böda-dögam (s), *n.* the left side.
bŏda-get, *n.* the left hand.
bögail bögail (?), Petelu kuikaiman bögailbögail gudötadiz, Peter began to deny with cursing and swearing. Mark, xiv. 71. Cf. List of Introduced Words.
bögi (s) *n.* a staff, a walking-stick.
boi, böi, *v.* to come, = boie.
boia (B), *n.* light, = buia.
boibasamu (B), boibisom, *n.* the eyebrows, = babasam.
boibata, *n.* a sister (see babatö, barabatö).
boie, *v.* to come, = boi.
boie (s), *n.* the voice.
boii (Mb), *n.* a basket made of coco-palm leaf. Cf. baili.
bökadongö, *n.* a circle.
bom (M), *n.* a cluster of pandanus fruit.
boradar, *n.* earth, = baradai, baradar.
borbaradö (?), noi gurugui nagepa puruka borbaradö gamu asimpa tana mulpa, he looked round about on them with anger. Mark, iii. 5.
börodan, = boradar.
börupudaizinga, *n.* crumbs; magina kaziu börupudaizinga, the children's crumbs. Mark, vii. 28.
bötainga = batainga; möge bötainga, morning long before day.
botaiginga,
bradar (B), *ad.* here.
bru, *n.* an anklet (332).
brua (Mb), *n.* an anklet made of coco-palm leaf.
bru-mada (M), *n.* the calf of the leg.
bru-rida (M), *n.* the shin bone.
bu, *n.* the conch shell, *Fusus proboscidiferus*, used as a trumpet

bu, *n.* the Pleiades. Cf. kusali.
bua (M), *n.* the bow of a canoe.
bua (Mb), *n.* the wild yam ; (M) *Calladium esculentum.*
buai (M), *n.* the bow of a canoe, = bua.
bŭbŭ (M), *n.* a stream of fresh water.
buadö, *n.* the side. [buadönu, buadia]
buboam (M), the egg cowrie shell. (*Ovulum*). Cf. boboam.
bubu (S), *n.* the tide.
bubuam (Mb), a shell. (*Ovulum*).
bud, *n.* paint made from crushed coral used in mourning, hence *n.* mourning.
budadigamö. (B), *n.* the left side, = böda-dogam.
budăman (M), *a.* flooded (lit. made muddy).
budi (M), *n.* a shell, the small periwinkle.
bug (Mb), *n.*, ratan.
bugĭri (B), *a.* blind.
buia, *n.* blaze, flame.
buiêli (M), *n.* flame; (prob. *pl.* of buia).
buiu, *n.* a glass bottle; buiu ngukulnga, a pitcher of water. Mark, xiv. 13. Cf. boii.
buji (M), a cane (*Flagellaria*).
buk (Mb), *n.* a small mask.
buk, *n.* a common Siluroid.
bukö (S), *n.* sand.
buli, *n.* a fly.
bume (M), *n.* the frontlet of the *dri.*
bupa (S, B), *n.* the bush, the forest, uncultivated land; iamuliz nubepa senabi bupau kuikungu, spoke to him in the bush. Mark, xii. 26. [bupau, bupapa.]
bupariz, *v.* to flee. Mark, v. 14. Cf. bupa, ariz.
bupur, *n.* floor.
bura, *n.* a leaf (?). Cf. urapabura.
burbur (T), *n.* a small drum, = bŭrubŭru.
burdö (M), *n.* grass, thatch. Cf. bardö.
burker (M), *n.* charcoal.
burkui, *n.* a leak.
bŭrom, *n.* a pig.
bŭrubŭra, *n.* a small cylindrical drum. Cf. burbur.

burugamul, burugömul, *a.* ripe; burugömul kousa, when the fruit is brought forth. Mark, iv. 29; burugömul mael, *n.* harvest Mark, iv. 29.

burugo (M), *n.* the horsefly (*Hæmatopoda*).

bŭrum, burumö (M, B), *n.* a pig, *pl.* burumal. [burumau, burumepa, burumia.]

būrūm (S) = bŭrum.

bŭta (M), *n.* the wing of a bird.

buta (?), senabi buta haua ukamodobilgal, *buta* haua sikis, buta haua nain, *about* the third hour, sixth hour, ninth hour; senabi göigöi butanu moidemin, the day of the preparation.

buta (B), *n.* a gate, a passage; butaginga, no passage. Mark, ii. 2.

butapa, *n.* a heir.

butö, *n.* autumn.

butu (M), *n.* sand, a sandy beach.

butupalizi, *v.* to shake off; butupalizi ngitamun sanangu poi, shake off the dust from your feet. Mark, vi. 11.

butupataipa, *v.* to cleanse, prepare, mend, heal. [butupatan, butupataizinga.]

butupataiginga, *v.* not to clean.

butupataizinga, *n.* washing.

butapötaiginga = butapataiginga.

buzar, *n.* and *a.* fat.

buzö, *n.* a reed.

buzu (M), *n.* the back stays of a boat.

DA (B), the breast or bosom.

dabai, *n.* the booby bird.

dabari, *n.* = dabai.

daboi, *n.* the king fish (*Cybium*).

dabu (Mb) = daboi.

dada, dadö, *n.* the middle; dadaget (Moa) the middle finger; dadakubilu, *n.* midnight; dada-dim, dada-dimu, *n.* the middle finger; the number three, in counting on the fingers; dadagöiga, dadö-göiga, *n.* mid-day, noon.

dadaig (M), *n.* the third brother.

dadalö, *n.* the centre, middle.

dada-mamain, dadömamain, *v.* to divide.

dada-mangizö, *v.* to meet (lit. come to the middle).
dadan, *prep.* between.
dada-pasa, *n.* a window.
dadeima-matameipa (M), *v.* to kill.
dadeipa (M), *v.* to die.
dadia, *n.* Mark, v. 22, 30; dadia adan, came out to meet; mabaegia dadia mura, in the press. Cf. dada.
dadir (Mb), the sternum. Cf. kosa.
dadu, *n.* a flag-like streamer made from coco-palm leaf.
dăgam (T, M), *n.* the bird of Paradise (*Paradisea Raggiana*); the head-dress made of paradise feathers used in war.
dagö, *a.* weak.
dagoi (M), *n.* a head-dress made of cassowary feathers used in a dance; dagoi sam (T). Cf. samĕrar.
dagori (M) = dagoi.
dai-bradara (B), *n.* clay.
daje (M), *n.* a petticoat, = gagi.
dak, dakö, *n.* the temples.
dalnga (S), *a.* kind (lit. possessing a bosom; see *da.*)
dalpimau-mabaig, *n.* lust. Cf. darpiam.
damu (S), sea-grass; ialdamu, kadapădamu, paradamu, different species of *Cymodocea.*
dan, danö, *n.* the eye; *pl.* danal; danö-ngurngomizö, *n.* religion (Macfarlane); danal-pataipa, *v.* to watch.
dana (T), a tooth; *pl.* danala.
danăgi, *a.* blind (lit. without eyes.)
danakuku (B), danakoko (M), *n.* the ankle.
danakukuro (T, M), *n.* an anklet, made of coco-palm leaf.
danaleg (M), *a.* alive (lit. possessing eyes).
dana-muktaean, danömukötaean, *v.* to glance at, to watch.
danal-patai, *v.* to look after, watch.
dana-pataipa, danal-pataipa, *v.* to watch.
dana-nuki (M), *n.* a spring. Cf. the Samoan, etc., mata-vai, spring, the (M) and Samoan are both literally eye-water.
daneipa (M), to rise, as the sun.
dang (B), *n.* a border or edge. Cf. dang, teeth.
dang, dangö, *n.* the teeth.
danga-kikiri, *n.* tooth-ache.

dangal, *n.* the dugong (*Halicore australis*).
danga-mai (MB, T), *n.* a crescent-shaped ornament of pearl shell (lit. tooth of pearl) (340).
danga-mari (M), *n.* = danga-mai.
dani, *n.* a tree.
dănilkau (MB), *n.* one of the performers in the funeral dance (404).
danö-paliz, *v.* to be awake.
dan-taean, *v.* to exhort.
danule (M), *a.* wanton.
daoma (M), *n.* yellow ochre.
dapar, *n.* a cloud (M); the sky, heaven. [daparao, daparau, daparpa, daparngu, daparnu.]
dapurkup (T), *n.* necklace.
daraba, *n.* a plantation.
dărai = durai. Mark, vii. 4.
darbanu (?)
darpapa, *n.* a bush (?). Cf. daraba.
darpar (?) = dapar.
darpiam, *n.* fornication. Mark, vii. 21. Cf. dalpimau.
darubi (N), *n.* a bamboo jew's harp.
darubiri = darubi.
daui (S), a banana.
daualban, *n.* a row; *v.* to row. Mir. segise.
dauda-laig, *n.* heathen.
dauma (M), *n.* the period of mourning.
dawal, *v.* to look (?).
dawb (M), *n.* a yam.
dega (MG), *n.* the sun.
deka (?), ngoimulpa deka muliz, tell us. Mark, xiii. 4.
dêla (M), *n.* a plant (*Scaevola Koenigii*).
delupeipa (M), *v.* to drown.
der (MB), a kind of breast plate made of coco-palm leaf, which formed a sort of yoke round the neck and extended down the chest, being tucked beneath the wakawal.
dêrabu (M), *n.* a wild yam.
dĕri (S, M), *n.* a white feather head-dress, = dri.
dewa-dagamola (T), *a.* yellow.
dia, *n.* a cloud. Mark, ix. 7. Cf. jia, zia.

diabo. Mark, v. 13.
diadi, *n.* a sponge.
dibagö, *n.* dew; (B) a fog.
dibidib, dibidibi, *n.* a round shell ornament, the top of a cone shell ground flat; a dish made of shell.
dĭgidĭgi (M), *n.* a white duck.
dimunu-pagan, *v.* to pinch. Cf. dimur.
dimur (MB), *n.* a finger.
dipaman, *n.* an oath.
dirdimai = dörödimöin.
diuidu, *v.* to retain; ngitamun pawa diuidu, your tradition. Mark, vii. 13.
diwanamani (B), *v.* to rejoice (prob. = diwana-mani, make a dance).
diwapa, *v.* to dance. See gamu-diwapa.
diwi (M), *n.* a scorpion. Cf. idiidi.
do, *n.* a bridge.
döam (MB), *n.* the cross ties inside a canoe.
doar, *n.* a black sea fowl.
döba-buada, *n.* the wayside. Mark, iv. 15. Cf. buadö. [döbabuadanu.]
döbu (S), *a.* old, rotten.
dobunga, *a.* rotten.
dobura, döbura (always with mata); mata döbura, *ad.* immediately.
dödolae, *n.* the second brother. Mark, xii. 21. Cf. dada, alae, dadaig.
dögam, *n.* a place; a bed; table. Mark, vii. 4; the floor. [dogamunu, dokamnu.]
dögaman (? dögamanu, from dögam), in its place. Mark, xiii. 14.
dogei (M), *n.* the planet Jupiter (?) Cf. dorgai.
doid, döidö, *n.* a plain, a wilderness; balpudai döid, a market. [döidpa doidönu.]
dökal (?), ngita ngulaig amadan dökal natizö, ye know summer is nigh. Mark, xiii. 28.
dokam, dökam = dögam.
dokap, dökopi, *n.* the thigh; kuiai torik dökopingu pardan, drew a sword from the thigh. Mark, xiv. 47. Cf. drakapi.
dongan,
dönga-wakasin, *n.* a savage (Macfarlane).
döpuza, *n.* an old thing; döpu = döbu.
döra-tudan, *v.* to weed.

dordiman, *v.* to draw out.
dordimoin = dörödimöin.
dorgai, *n.* a kind of bogey or spirit; a constellation.
dorgai kukilaig, *n.* a constellation (Haddon, Legends I. 31).
dorgai waralaig, *n.* a constellation (Haddon, Legends I. 31).
dorodimai-lagö, *n.* prison (lit. bondage-house).
dörödimöin, *v.* to bind; to imprison; to hang.
dörödimoizinga, *a.* tied; *n.* fetters.
drakapi (M), *n.* the thigh. Cf. dokap.
dri (Mb), *n.* the cockatoo (?) (Legends, p. 29). Cf. wem.
dri, *n.* a head-dress made of white karbai feathers.
drí grer (Mb), dri gïrer (M), *n.* the dance in which the dri was worn (362).
drudrupizö, *v.* to drown. Cf. dudupizö.
drurai = durai.
du (?), ita du tonaral, these signs. Mark, xvi. 17.
dua (M), *n.* the cashew nut.
dub (S), *n.* a swelling.
dubidubia, *v.* to murmur.
dubiruna (B), *n.* a wound.
dudupizö, *v.* to overthrow, drown; to overwhelm; to dip in a liquid; dudupan senabi pagara vineganu, dipped a sponge in vinegar. Mark, xv. 36. [dudupan.]
dugunga, *a.* blunt.
duia-adan, *v.* to be convalescent.
duiumö (M), *n.* thunder. Cf. giginö.
dukun, *n.* a tree with hard wood.
dulbor (M), *n.* a fish. (Jukes.)
dumawagu, dumawaku, *n.* calico, cloth (cf. waku), *pl.* dumawakul. angai-dumawaku, *n.* garment. [dumawakuia.]
dumawaru (B), *n.* cloth.
dumawk (M), clothes.
dun (M), *n.* the eye-ball. (See dan.)
dŭna-kukur (M), *n.* an anklet of coco-palm leaf. Cf. brua.
duna-samu (B), *n.* the eyelid.
dŭngal, *n.* the dugong (*Halicore australis*). Cf. dangal.
dungulö (M), *n.* an opossum.
dupu (B), *n.* elephantiasis of the legs = dub.

dupu (M), *n.* the bronzed ant; the ague.

dŭra (M), *n.* the breast, chest, mammae, = da.

durai, *a.* some; inabi durai, these; senabi durai, those.

durai-ina, *a.* these.

durai-siei, *a.* those.

durai-wanan, *v.* to remain (lit. some are left).

durö, *a.* = durai; tana gasamizö ita durö tabul, they shall take up serpents. Mark, xvi. 18.

durpum-gigo (s), *n.* thunder.

duru (?), kusa duru (M), a band of beads worn on the wig.

duru zönga, *a.* some things; duru zönga lupaliz, some wonders. Cf. durai.

Ege (?), kawaku ege kutau pawa, lasciviousness. Mark, vii. 22.

ejena (M), *n.* an insect (*Cicada*).

eka, *v.* to wish.

el, *suffix* denoting the plural of nouns.

elari, *n.* a fruit (*Wallrothia*) (308).

eldrada gomola (T), *a.* green.

elma (T), *n.* a species of snake.

enti (M), *n.* a spider.

eso, *v.* to thank.

Fad, *v.* a bird's nest.

fada = fad, pad.

Ga, *n.* a hornet.

ga, *n.* the central star in the constellation dorgai-kukilaig.

gabagaba (M), *n.* a club with a plain stone disc.

gabagup (Mb), *n.* a stone club, = gabagaba.

gabau, *n.* a yam.

gabogabo (B), *n.* a stone club, = gabagaba.

gabudan, *v.* to be slow.

gabu-maita (B), *n.* bowels.

gabunga, *a.* cold, cool.

gaet (s), *n.* coral.

gaga (Mg) = gagari.

gagadinga, *a.* weak, faint; defeated.

gagai (M), *n.* a bow; (B), a gun; a dance (362). Cf. gagari.
gagal (M), *n. pl.* bow and arrows.
gagari (T), *n.* bow and arrows; triger gagari, a gun.
gagauro (B), *n.* a bowstring.
gagi, *n.* an ear-ring.
gagi, *n.* a shrimp.
gagi (M), *n.* a large petticoat made of shredded leaves, and worn by women.
gaibur (M), *n.* the she-oak (*Casuarina*).
gaidesa (T), *n.* a shield.
gaiga (B), *n.* the sun, = göiga.
gaiga-buia (B), *n.* twilight.
gaigai (T), *n.* the king fish; the white fish.
gaiga-pudisö (B), *n.* the west (lit. sun-down).
gaima (M), an abscess, boil.
gaina (B), *n.* taro, = göen.
gainau, gaino, *n.* the Torres Strait pigeon (*Carpophaga luctuosa*).
gainöwa (M), *n.* a white pigeon (see gainau).
galalupa (MG), *v.* to be cold (Stone).
galupan, *v.* to shake; gamu galupan, *v.* to tremble.
gam (T), *n.* skin.
gam (T), fat.
gamakauwasina (B), *a.* lazy.
gamalunga (B), *n.* an albino. Cf. gamul, gamulnga.
gamu, *n.* the body. [gamupa, gamungu, gamuia.]
gamuasin (?), puruka parö madö gamuasin, an evil eye. Mark, vii. 22.
gamu-diwapa, *v.* to dance.
gamu-doidanu, *v.* to be tired. Cf. doid, nu.
gamu-dumawaku (S), *n.* clothing; a dress.
gamuia-mataman (B), *v.* to murder; gamuia-mataman-mabaeg (B), *n.* a murderer.
gamuidan, *v.* to ignite, to burn.
gamuji (M), *a.* itchy.
gamul, *a.* white.
gamulnga (M), gamulönga, *a.* white, red (?).
gamunguzilamiz, *a.* wild (gamungu, from body, zilamiz, run).
gamutariz, *v.* to touch.

ganguimizi (?), see garoguimizi.

gangurö (M), *n.* a large lizard.

ganu, *n.* a smell; *pl.* ganul.

ganul, *a.* possessing smell, scented; ganul pui, *n.* sweet spices. Mark, xvi. 1.

ganupulman, *v.* to smell, make a smell.

gapu, *n.* the sucker fish (*Echeneis naucrates*), used by the natives in catching turtle (349).

gar, *suffix.*

gara (M), *n.* *Pandanus spiralis.*

garabo (? gara, *n.* the edge); tana kai garabö tradiz nongo dumawakuia, they might touch the border of his garment. Mark, vi. 56.

garagar (B), *a.* feeble.

garguimizi = garöguimizi.

garakazi, *n.* a boy, a male (lit. male person). [garakaziu] garakaziu.

garbad (MB), *n.* the gunwale of a canoe.

gariga (M), = göiga; gariga-titure (M), *n.* the morning star; garig kap (T), a dance held in May when fruit is ripe, and connected with the star kererki (365).

garkai (M), *n.* a man (black man).

garkaije (M), *n.* a tribe; men, women, and children.

garo, garö, *Prefix.*

garoguimai (B), *n.* an earthquake.

garo-guimizï, *v.* to quiver, to swing. [garoguimani], garöguimizin, *n.* earthquake.

garö-nanamiz, *v.* to throng, crowd.

garö-ngalkan, *n.* hypocrisy.

garo-palagiz (?); noi matadobura tanamulpa garöpalagiz, he immediately talked with them. Mark, vi. 50.

garo-pataman, *v.* to collect food in large quantities. Sam. to'ona'i.

garo-taean, *v.* to press or touch (?).

garo-toitaean, *v.* to repent.

garouian, *v.* to spread about (?), garouian senabi ia, to blaze abroad the matter. Mark, i. 45.

garowalgaipa, *v.* to wash. [garowalgan.]

garöwalgaiginga, *a.* not washed.

garowaragan, *v.* see garowalgaipa.

garö-weidamoin, *v.* to assemble, gather together; to approach.
găru (M), *n.* the sugar cane, = geru.
garuidamainö (B), *n.* a load.
gărur (M), *n.* a small wasp.
gasa (M), = görsar.
gasameipa, *v.* to catch with the hands, to press, seize, squeeze; (B), to hunt (kangaroo). [gasamizö, gasaman, gasamöiginga].
gasamoiginga, *pl. v.* not to take.
gat (Mb), *n.* a coral reef.
gata (M), *n.* shallow water. See gat, gato.
gatapogai (B), *v.* to dig ground for a garden.
gato, *v.* to ebb. See gata.
gauăda (M), *n.* a salt water swamp.
gaugu, *n.* medicine.
gaur, gaurö (?), ngita mulpa gaur irun, more shall be given to you. Mark, iv. 24; nabi kawa ina ngaeapa gaurö irun senabi iragud, this people honoureth me with lips. Mark, vii. 5.
gawai (Mb), name of a plant; "rope along bush," chewed in the initiation ceremonies (398).
gawata (B), *n.* a lagoon (see gauăda).
gedö = geto.
gegeda (S), *n.* faintness; *a.* faint.
gegetö-pugan (?), Augada gegetö pugan, the blasphemy. Mark, xiv. 64.
ger, *n.* a water snake.
geriga (M), *n.* sun, = göiga.
gerka, *n.* the gall bladder (of a turtle).
geru, *n.* the sugar-cane; g'ru tha mităle (M), sweet tasted. Cf. garu.
gerukizi (T), *n.* a man, male, = garakazi.
gĕt, getö, *n.* the arm or hand; *pl.* getal; gerukisi get (T), *n.* a man's arm. [getau, getan, getangu, getia.]
geta-digamo (B), *n.* the right side, = getö dogam.
getal (M), *n.* fingers.
getăli (M), *n.* a large crab, = gitalai.
getauza (Mb), *n.* rayed discs held in the hand whilst dancing. Cf. kababa.
get-idiz, *v.* to read.
get-matamizö, *v.* to strike the hands together, to clap.
getö, get, *n.* the hand, fore-arm, (M) a finger.

getö-dögam, *n.* the right side. [geta-dogamunu.]

getö-langai, *v.* to despoil, damage, appropriate. [getolangan, getalangailai.]

geto-langaizinga, *a.* injured; shamefully handled. Mark, xii. 4.

getö-nitun, *v.* to point at.

getö-oidan, *v.* to push.

getö-pagaean, *v.* to lay hands on, to apprehend [stretch hands.]

getö-pudeipa, *v.* to scrape hands, the native mode of salutation.

getö-titai, *v.* to read.

getö-tridai, *v.* to read, = getö-titai. [getö-tridizö.]

getö-tridaiginga, getö tritraiginga, *v.* not to read.

getö-uian, *v.* to reach.

getö-wani, getö-waniz, *v.* to let go, release, abandon; to allow; to lose; forgive. [getowanemiu, getöwanemin.]

getö-wönaiginga, *v.* not to allow. Mark, vii. 12; not to forgive. Mark, xi. 26.

gi, *n.* a knife; gi-turik, *n.* an iron knife.

gi, *n.* a tusk.

gi, *n.* laughter; gi-waleipa (M), *v.* to laugh.

gi (B), *n.* an old dry coconut.

gi (M), *a.* ripe.

gi = igi; zagi, *a.* poor.

gia-paleipa (M), *v.* to cook.

gido,

gigal, *suffix*, used with adjectives.

gigi, *n.* thunder. [giginö.]

gigo, gigö, *suffix* expressing the want of anything; za gigö, without a thing, poor.

gigu (T), gigub, *n.* a nose ornament. Cf. gub.

gima-nanitan, *v.* to run over; tana gima nanitan siauki, they ran there afoot. Mark, vi. 33.

gimal, gimalö, *ad.* and *prep.* on, over, up, above. [gimaingu, gimainu.]

gimael, *suffix.*

gimamani, *v.* to reap.

gimia, *ad.* over.

gin (MG), *n.* taro.

ginga, *suffix* denoting non-possession.

gio (B), *n.* laughter, = gi.

girar, *n.* a dance.
girer (B), *n.* a dance.
girka,
gitalai (B), *n.* a crab, = getăli, gitulai, gitila.
gita = get, getö.
gitalenga, *a.* having a hand.
gĭtĭla, *n.* a crab, = gitalai, gitulai.
gitri (MG), *n.* a knife.
gitulai, *n.* a crab, = gitalai, getăli, gĭtĭla.
giu (S), *n.* laughter, a laugh.
giun-pungaipa, *n.* foolishness.
giung (M), *a.* cooked.
giure (M), *ad.* no.
giusalman, *v.* to deride.
gi-waleipa (M), *v.* to laugh. [gi-waliz.]
gizu, *n.* a point, an edge, a cape; (M), sharpness.
gizuge (M), *a.* blunt (lit. without point).
gizule, *a.* possessing a point; sharp.
gizu-paleipa, *v.* to cut a point, to sharpen.
gö,
goa (S, T), *n.* the seeds of *Pangium edule* used as rattles. Cf. gua.
goagalnga, *n.* a leak.
goalnga, *a.* leaky.
goba (B), *n.* a stone axe.
gobai (M), *n.* the larva of the ant-lion (*Myrmeleon*).
göen, *n.* taro.
gogadinga, *a.* feeble, weak.
gögainga, *a.* weak.
gogob,
goguta (M), *n.* the cotton tree (*Bombax*).
göiga, *n.* the sun, daylight, day; *pl.* göigöil. [göigöinu.]
göigöi = göiga.
gŏmŏla, *suffix* used with names of colours.
gömu = gamu.
göinau, *n.* the Torres Strait pigeon (*Carpophaga.*)
gönau, *n.* the skin.
gongau, *n.* the scalp.
gonza (S), *n.* health (? göuga).

gŏpagop (M) = gabagaba.
gorbotot, *n.* a wooden club.
görkozi = garakazi. [görköziu, görközipa, görkozingu.]
goröközi = görkozi.
görsar, *a.* many (usually with köi, köi-görsar).
göru-ridö, *n.* the back-bone, spine. Cf. taburid.
görzö, *n.* the bowels.
goua (B), *n.* a ditch.
göuga, *n.* a hat.
göuga, göugu, *n.* a doctor (see gaugu); medicine. [göuguan, göugungu.]
goura (B), *n.* a pigeon.
gragri *n.* fever.
graka (Mg), *n.* man, = garakazi.
graz (M), *n.* a fish trap or weir built of stones on a reef.
grer (M), *n.* a dance, = girar.
gridö (Mb), *n.* the back. Cf. gorurido.
gua (Mb), *n.* seeds used as a rattle, = gooa; *pl.* gual. Cf. goa.
guago, *n.* a hole.
guai, *a.* bald.
guapi (M), *n.* klakaguapi, the shaft of a klak.
gub, guba (M), *n.* a nose stick.
guba, gubö, *n.* the wind, *pl.* gubal; köi-gubö, *n.* a storm.
gŭbagŭba = gabagaba.
gubal-puian, *v.* to blow.
gubau, *n.* a yam.
gubau-puilaig (Mb), *n.* the wind-man, a sorcerer producing wind (401).
gubö = guba.
gud, gudö, *n.* the mouth; an opening; iragud (M), *n.* the lips; pasagudö *n.* a door; maram gudö, *n.* a pit door, a tomb. Mark, xv. 47, xvi. 2.
gud (Moa), *n.* a mouth board. (404).
gud (Mb), *n.* a coconut water vessel. (404).
gudagö (?), korawaig tana ai gudagö asigi, they cannot fast. Mark, ii. 19.
gudaguda,
gudalnga (?), ngi sigo gudalnga, thou art not far. Mark, xii. 34.

guda-magêda (M), *n.* the moustache.
guda-moin (s), *v.* to discuss.
guda-palamiz, *v.* to overflow.
guda-purutan, *v.* to be insolent.
gudaran, *v.* to betray; **aimiz-gudaran** (s), *v.* to betray.
guda-taean, *v.* to sacrifice.
guda-toridan = **gudö-toridan.**
guda uiailai, *v.* to be forgiven. Mark, iv. 12.
guda-wodian, *v.* to dismiss.
gudawali (Mb), *n.* the lashing fastening the head of a javelin to its shaft.
gudazi-poidizi, *v.* to save, to heal.
gudia-ieudaipa, *v.* to fill, to be full.
gudop, *n.* the beard.
gudo-matamiz (?). Mark, iii. 5.
gudop-iata, *n.* the moustache.
gudö-nitun (s), *v.* to advise.
gudö-tadiz (s), *v.* to deny.
gudö-tapamoin, *v.* to kiss.
gudö-tödaiginga, *v.* not to deny.
gudö-toridan, *v.* to compel.
gudö-waean, *v.* to unload, to unloose.
gudö-wadan, *v.* to be quiet, hold one's peace. Mark, x. 48; to allow. Mark, v. 37.
gudö-waig, *v.* to unloose, to forgive. [gudauiailai, gudöwaeamai].
gudö-wodian,
gud-paliz, *v.* to bud.
gudria-ieutiz [?], press of men. Mark, ii. 4.
gudu = **gudö.**
gudu-tapaman, *v.* to kiss. [gudö-tapamoin.]
guêle (M), *a.* bald, = **guai.**
gŭgŭre (M), *n.* a bow, = **gagai.**
gugus, *v.* to dig.
guigui, *n.* a collective name for the firesticks, (385); (hence, matches). Cf. salgai, sagai, ini, iaka.
gui-waliz, *v.* to mock.
gul, gulö, *n.* a boat, canoe; *pl.* **gulai.** [gulab, gulpa, gulöpa, gulngu, gulai].

gulab, gulabö = gulpa. See gul.

gulan (?), iegese gulan, *v.* to cast lots. Mark, xv. 24.

gulgupö, gulugupö, *ad.* round about; gulugupö nagepa, to look round about. Mark, xi. 11; köbia gulgupö zilamizö, ran round about through. Mark, vi. 55.

gulngu-rugal, *n.* a cargo; baggage or goods from a ship.

gulugul,

gulungu = gulngu.

gul-waku, *n.* a sail, (lit. boat-mat).

gumi, *a.* secret; *v.* to conceal; *ad.* privately, secretly; gumi turan, *v.* to call aside.

gumiginga, *a.* not hidden.

gŭmulĕ, *suffix* used with names of colours. Cf. gŏmŏla.

gungau (B), *n.* skin, (see gonau, gongau).

gurabi (M), *n.* a white lily (*Crinum* ?).

gurba (M), *n.* a small crab.

gurgu-uzaru. See gurugui, uzar.

gurgui (?), pawa gurgui, *n.* tradition. Mark, vii. 9.

guru,

gurugui (s), gurgui, *ad.* around, round about.

gurugup = gulgspö.

gusi (s), *n.* a pillow.

guzi, *n.* a pillow, = gusi.

gwarabatutu (M), *n.* a stone club with numerous blunt projections.

gwarapatutu (B), *n.* a stone club, = gwarabatutu.

Ia, *n.* a word; language.

ia, *suffix* to nouns.

ia, *n.* the throat; (B), the œsophagus. [iapa, iangu].

ia, *conj.* and.

ia, *a.* loud.

iabu, *n.* a path, a road; babu-iabu, a ditch (lit. stream-road) gubau-iabu, a vent (lit. wind's path). [iabuia].

iabu-gudö, *n.* a path, a road. [iabugudapa, iabugudanu, iabugudia].

iabuiawai. Mark, viii. 14. Cf. iabu, iawa.

iadai-iadai, *n.* a messenger.

iadăl (Mb), *n.* string.

iadi, *n.* a stone anchor.

iadu-palgan, *v.* to tell, relate, confess, reveal. [iadupalgailai].
iadu-titan, *v.* to caution.
iadu--turizi, *v.* to inform.
iadu-wadan, *v.* to caution.
iaga (s), *n.* silence.
iagamiz, *v.* to wonder. Mark, v. 42.
iagasin (s), *a.* dumb.
iagetamani (b), *n.* a message.
iagi, *a.* dumb, without words; iagi-mari, a dumb spirit. Mark, ix. 17.
iagiasin, *v.* to be silent.
iagi-bödai, iagi-botai, *a.* dumb.
iagigö, *a.* dumb.
iaginga, iöginga, *a.* no words, nothing.
iagudagudangu (?), tana iagudagudangu töeaipa, they were making a tumult. Mark, v. 38.
iaia,
iaiame, *v.* to burn, = ieame.
iaiămiso (b), *v.* to burn.
iaka, (m) *n.* the sheath which protects the ends of the two fire-sticks, and keeps them dry, and usually decorated with shi and timi kapul.
iakaman, iakman (s), *v.* to acquaint, to inform, to declare.
iakanoriz, *v.* to forget.
ial, *n.* the hair of the head; a wig (m); feathers.
ial-ai (mb, n), *n.* hair twisted in curls.
ial-bupö (mb, n), *n.* hair when short.
ialdamu (mb), *n.* a species of *Cymodocea.* Cf. damu.
ial-kapö, (b), *n.* curly hair.
ial-pat (n, t), *n.* a comb.
iămar (m), *n.* a species of coral, branched.
ia-mui-taean, *v.* to command.
iamulaigia, iamulaiginga, *v.* not to say.
iamuli, *v.* to speak.
iamulizö, *v.* to speak.
iăna (t), *n.* a basket; a bag; a sack. Usually made of coco-palm or pandanus leaf. [iananu.]
ianalö, *pl.* of iana.
iananab (?), iananab nubepa iamuliz, say to him one by one. Mark, xiv. 19.

iananga, see Grammar. Nouns, 4, i.

ianga,

ianga-kudru (s), *n.* language.

ianga-ngadalnga (s), *n.* a metaphor, a parable.

iange (?). Mark, viii. 33.

iangu-kudu, *n.* speech, language; ngitamun urapon iangukudu, your language (is) one.

iangu (?), ina pawa iangu ngadalnga, the parable.

iapaladö, *n.* the lungs.

iapar, *n.* a band (?); kula iapar taizi nongo katrö, a stone band put on his neck. Mark, ix. 42. Cf. next word.

iaparal (MB), *n. pl.* ornamental bands worn on the body in the merkai dance, red, black, and white.

iapepa (M), *v.* to choose, to select.

iapopoibiz, *v.* to ask, to question, to beg.

iapopoizö, *v.* to ask. Mark, iv. 10.

iapupoibepa, *v.* to ask.

iaragi (s), *a.* angry.

ia-supaman, *v.* to bear false witness.

iata, *n.* the beard, whiskers, etc.

iatai, *n.* a band or company, a row of men; *pl.* iatial; *ad.* in ranks. Cf. Mir. nosik.

iataman, *v.* to be angry.

iata-patizö, *v.* to shave.

iataran = iaturan, *v.* to contend, to be divided against, see iatormai.

iatial, *pl.* of iatai.

iatizi, *v.* to ooze, to come in, of water; ban sik iatizi gulöpa, waves beat into the ship. Mark, iv. 37.

iatormai (?), iatormai kuikulunga, *v.* to make insurrection; tonar ia taramai, insurrection time. Mark, xv. 7; iatorö moipa, *ad.* for envy. Mark, xv. 10.

iatu (T) = iata, *n.* the beard.

iaturan, *v.* to contend.

iauakazöuedan, *n.* a noose.

iau-kawa, *n.* a market.

iaumai-laig (s), *n.* a council house.

iauman, *v.* to discuss.

iautiz, *v.* to hoist.

iautumiz, *v.* to command; *n.* command. [iautumizi.]

iautumoizinga, *n. pl.* teachings, commands.

iawa, *v. imperat.* farewell! good-bye!

iawaig (?), noi iawaig siëi mabagi lago, he was without in desert places. Mark, i. 45.

iaweipa (M), *v.* to see, look after, watch.

iba-eba, (M), *n.* sandstone.

iban (S), *v.* to rub, to scrape.

ibara (M), *n.* a crocodile (perhaps introduced from Daudai). Cf. kodal.

iböpoidan (B), *v.* to hunt (men).

ibu (M), *n.* the chin, lower jaw.

ibupoidan, *v.* to help, to assist.

id, idö, *n.* a small bivalve shell.

idai = iadai, mina idai, *n.* gospel, Mark, i. 14; warö idai, some messengers; setabi idai, those people. Mark, xvi. 14.

idaig (?), *suffix*; tratra idaig, stammerer; ngölkai idaigal, hypocrites.

idara, *n.* a beetle.

ideipa, *v.* to unloose, untie.

ideipa (M), *v.* to scold.

idi, *n.* oil.

idiidi (M), *n.* a scorpion. Cf. diwi.

idiidi (M), *a.* fat.

idiman (?), tana kuik idiman they wagged their heads. Mark, xv. 29. Cf. idun.

idimizi, *v.* to destroy, to erase. Cf. idumai. [idumoin, idumoiginga.]

idin (?), noi kuikuiömo nida idin senabi durai kikiri. Mark, vi. 57.

idö, *n.* a small bivalve shell.

idöi (?). Mark, xvi. 12.

idumai *v.* to vanish. [idimizi].

idumiz, *v.* to melt. Cf. idumai.

idun, *v.* to mock.

ie,

ieame, *v.* to burn.

ieda, *n.* the gill of a fish.

iedai (B), *n.* a rumour, = iadai.

ieda-waianö, *v.* to warn. See iadu-wadan.

iege,

iege-palan, iege-paran, *v.* to mock, to revile.

iegese (?), iegese gulan, *v.* to cast lots. Mark, xv. 24.
iegiadon, pleased (?). Mark, vi. 22. Cf. ia, gia, adan or dan.
ielai (M), *n.* the crest of a cockatoo.
ielpaman, *v.* nongo kalmel ielpaman ita watri mabaegal, he was numbered with bad men. Mark, xv. 28.
ielpan, ielepan, *v.* to lead; niaipa-ielpanö, *v.* to lead to a seat, to marry.
iĕna (M), *n.* a basket, = iana.
iengu (?), ngau iengu mai, for my name's sake. Mark, xiii. 13.
iērka (M), *n.* wax.
ieso, *v.* to praise, to thank. Cf. eso.
iĕte (N), *n.* the spider shell (*Pterocera*s).
ietu (M), *n.* a barnacle shell found on the turtle.
ieudan (?), makiam ieudan, cried out. Mark, vi. 49.
ieudapa. See gudia ieudaipa.
ieude. See ieudepa.
ieudepa, *v.* to ask, to beg. [ieudizi, ieudemipa.]
ieudiz, ieutiz, *v.* to put. [ieudan.]
igalaig, *n.* a kinsman, a friend; *pl.* igalgal. [igalgöpa, igalgia.]
igalaigu (B), *n.* an uncle.
igaligal (S), *a.* glad; *ad.* gladly.
igi, *suffix* expressing want or non-possession.
igili, *n.* life.
igililemael, *n.* the living.
igililenga, igililönga, *a.* possessing life, alive.
igili-paliz, *v.* to give life, to save. [igili-palan.]
iginga, *suffix* expressing non-possession.
igipali = igili-paliz.
igur (M), *exclam.* of pity; poor thing!
iiwi (yiwi) (S), *n.* a mosquito, = iwi.
iilo (yilo) (B), *n.* the gall bladder.
ika, *n.* joy, gladness.
ikai (M), *n.* milk; sap; nipple of breast.
ikalikal, *ad.* joyfully, gladly. Cf. igaligal.
ikane,
ikan-pungaipa, *v.* to please.
ika-tiaipi, *v.* to please, to rejoice, to be glad.
ikur (S), *n.* a rope.

ilagiz (?), lakö kai pa ilagiz, the rent will again fly open. Mark, ii. 21, See palagiz.
ilamiz, *suffix*, against.
ilarköubö, *n.* flax (Macfarlane).
il-get (MB), *n.* the middle finger; the index finger in Moa. Cf. klaknetoi get.
ima,
imaiginga, *v.* not to see.
imaipa, imeipa (M), *v.* to see, to find; paru-imamöin, they saluted. [imiz, imizi, iman, imamoin.]
imaizigal, *n.* the person seeing a thing.
imana (B), *n.* the world.
imi (B), *n.* a spouse, husband.
imi (N), *n.* a sister-in-law.
imi-garkazi (B), *n.* a son-in-law (lit. husband-son).
imuliz-ilamizö, *v.* to say things against, to accuse, to envy.
imusö (B), a species of grass.
ina, inö, *a.* the, this; *ad.* here.
inabi, *a.* the, this; a, an.
inabi-durai (S), *pron.* these.
ina-nabiget (M), *n.* this hand; five.
inguje (M), *v.* to urinate.
ini, *n.* the penis; the vertical firestick. (385.)
inile, *a.* male (lit. possessing ini).
inil-tiam, *n.* a male turtle.
injura (M), *n.* a small lizard.
inö = ina.
inur (M), *n.* darkness, night. [inuria.]
iöbuia, *n.* by the way. See iabu.
io,
ioipa, *v.* to incline.
iöka *v.* to recline.
iönan *v.* to recline.
iöngu = iangu.
iounga, *n.* a porch. [iöungapa.]
ipal, ipêl, *pron.* both, two.
ipatamaiginga (?), ngi minaipatamaiginga, carest thou not. Mark, iv. 38.
ipataman, *v.* to finish.

ipatö, *v.* to finish.
ipatömaiging *a.* not believed. Mark, ix. 12.
ipi, *n.* female, wife, spouse. [ipiu, ipipa.]
ipiapö, (B) *n.* a fan; *v.* to fall.
ipidadö, *n.* evil, sin; *a.* bad.
ipidadö-pugan, *v.* to curse, to blaspheme.
ipïkai (M), *n.* female, woman = ipikazi.
ipikai-kaje (M), *n.* a girl.
ipika-merkai (Mb), a man dressed as a woman in the funeral dance.
ipi-kazi, *n.* a female, woman, wife (lit. female person).
ipoibisö (B), *n.* a noise.
ipökazi = ipikazi.
ipoközi = ipikazi, *pl.* ipököziel. [ipoközia.]
ipukaja burumö (B), *n.* a sow (lit. female pig).
ira (M), *n.* father- or mother-in-law.
irada, iradö, *n.* shade, shadow. [iradöpa.]
iradu-aban, *v.* to shade.
iragud, iragudö, *n.* the lips.
irka (M), *n.* resin, used in fixing the heads and joints of spears and throwing-sticks. Cf. ierka.
irun (s), *a.* mere.
irun (?), maita köiza irun, they were filled. Mark, vi. 42.
isau (M), *n.* a honey-comb, wax
isoa (Mg), *ad.* all right.
ita, *demons. pl.* those, the,
ita (M), *n.* an oyster. Cf. itro.
ita durai, *demons. pl.* some.
itar, *n.* a spotted dogfish (*Chiloscyllium*).
itra = ita.
itro, *n.* an oyster.
iuamai (?) wakaiuamai mabaeg, *n.* priest.
iudepa, *v.* to ask, beg, = ieudepa. [iudiz.]
iudiz-mulan, *v.* to pour (?).
iuna (Mg), *n.* sleep.
iuneipa (M), *v.* to lie down; to leave behind
iungu-ngulaig (B), *v.* to interpret.
iurdiz, *v.* to flow.
iutan, *n.* a grave.

inteipa (M), *v.* to pull, to drag.
iutizi = ielpan. Mark, xiii. 11.
iwai, *n.* the cloth-like spathe at the base of coco-palm leaves.
iwi, *n.* the mosquito.

Ja (MG), *n.* grass.
jag, *n.* a small species of fish.
jaga (M), *n.* a fish (*Lethrinus*).
jaji (B), *n.* a petticoat. See gagi.
jamo (M), *n.* the emu.
japudamino (B), *v.* to buy. See za-pudamoin.
japulaika (B), *n.* wealth, property. See zapulaig.
jaro, *n.* name of a card game. Probably introduced.
jawur (chawur) (M), *n.* a convolvulus with edible roots.
je (B), *n.* the south; (M) *n.* the sky.
jena (chena) (M), *demons.* that, these, those = sena.
jia, *n.* a cloud; scud.
jid (zheed) (M), *n.* a cloud. Cf. jia.
jina (china) (M), *v.* stop, enough! = sina.
jub (MG), *n.* the arm, shoulder. (Jukes.)
juma (shuma) (M), *n.* cold. Cf. sumai.
jur (M), *n.* the shoulder. (Jukes.)

Ka, *n.* the waist.
kab, kabö, *n.* a dance, = kap.
kaba, *n.* a paddle, an oar; kaba-nitun, *v.* to paddle, to row.
kababa (M), *n.* a disc held in the hand during a dance. Cf. getauza, kabuzapla.
kaba-get (MB), *n.* the thumb.
kabai, *n.* an egret.
kaba-koku, *n.* the great toe.
kaba-mineipa, *v.* to dance.
kaba-nitunö, *v.* to paddle, to row.
kaba-sia, *n.* the great toe.
kabĭ-get, *n.* the thumb.
kabĭ-kok, *n.* the big toe.
kabo-nădur (T), *n.* a tail ornament worn in dances. Cf. nadur, nadual, zamozamo.

kabu, *n.* the breast bone; chest (MG); the number ten in counting on the body.
kabu = kababa; kabu-zapla (T), a disc held in the hand while dancing. Cf. getauza, kababa.
kabudan, kabutan, *v.* to set on, to put on, to put before.
kadai, kadaipa, *directive ad.* up, upward; *v.* to stand.
kadainitaman, *v.* to stand by. Mark, xv. 35.
kadaipa, *v.* to stand.
kadaipa-palagiz, *v.* to spill.
kadaipa-poidan, *v.* to ordain.
kadaipa-waliz, *v.* to ascend, to climb up.
kadai-tanure, *v.* to stand up, to rise.
kadai-taraiginga, *n.* not to stand; not to endure. Mark, iv. 17.
kadai-taran, *v.* to lift up.
kadai-tarizö, *v.* to stand up, to rise.
kadai-tazö, = kadai-tarizö.
kadai-wapa,
kadalo,
kadaman, *v.* to tear; adapa kadaman, *v.* to peel; gamu kadaman, *v.* to tear the body. Mark, ix. 18.
kadapădamu (MB), *n.* a species of *Cymodocea.* Cf. damu.
kadazou = kedazou.
kadĭg, *n.* a gauntlet or arm-guard. (331.)
kadig-tam (M), *n.* the ornament of the kadig.
kadig-tang (MB), *n.* = kadig-tam.
kadik, *n.* a gauntlet or arm-guard.
kado (B), blood clots.
kadrö = kadai; kadrö palagiz. Mark, i. 10.
kae = kai.
kaet,
kaga (M), *n.* a grave.
kagiza,
kai (B), *a.* large, big; *ad.* very = köi; kai gulö (B), *n.* a ship; kai-waiwai, *n.* elephantiasis of scrotum.
kai (MB, S), *n.* a New Guinea mat. Cf. kaii.
kai, *particle* indicating the future tense; at the end of a sentence it is emphatic and = ki.
kai-alö (B), *n.* elephantiasis of the scrotum. Cf. kai, waiwai, kaiwaiwai.

kai-ari (B), *n.* a flood (lit. great rain).
kaiaru (B), *n*, a crayfish, = kaier.
kaiba,
kai-biribiri,
kaibö, *ad.* now, soon; to-day (B).
kaibrodo-gŏmŏla (T), *a.* white.
kaibu (M), *ad.* now, immediately, = kaibö.
kaied, *n.* a grandmother.
kaier, *n.* the crayfish; spiny lobster. Cf. kaiaru.
kaig (S), *n.* a post.
kaigas (Mb), *n.* a kind of shark, perhaps *Rhina.*
kaigasa (M) = köigörsar, a great many.
kaigerkitalgaka (T), a warrior. Cf. kĕrketegerkai.
kaigob (Mg), *n.* an arrow.
kai-görsar = köigörsar.
kai guba (B), *n.* a gale (lit. big wind).
kai gui (?), kaigui malu, *n.* the sea. Mark, ix. 42.
kai-gursaro = köigörsar.
kaigutal piti (B), *n.* a snout (lit. very long nose).
kaii (T), *n.* a mat made from the leaf of the Pandanus and imported from Mowatta.
kai-ib (S), to-day, = kaibu, kaibö.
kai-ipĭki, *n.* an old woman.
kaikai, *n.* a feather; (M) a quill.
kai-kosanö,
kai-maitalnga (B), *a.* corpulent (lit. possessing a big body).
kai mapunga, *a.* heavy.
kaimi (N), *n.* a brother-in-law.
kaimi, *n.* a mate, a companion, a follower; *pl.* kaimil; nongo kaimil, they that had been with him. [kaimia.]
kain, kaine, *a.* new; kain ipi, bride; mabaeg kain ipi gasaman, bridegroom.
kainga (?) Mark, iv. 6.
kaingulpa (?), burumal köi umen nanitan, diabo a padria, kaingulpa malupa, the herd ran violently down a steep place into the sea. Mark, v. 13.
kainĭdung (M), *n.* the new moon.
kaining (M), *a.* new, little used.

kaipui (B), *a.* a tree (lit. big tree).

kaisigalö = köisigal.

kaisigapa = köisigapa.

kaiwaiwai, *n.* elephantiasis of the scrotum. Cf. waiwai; kaialö.

kaiza (B), *a.* big, large (properly kai-za, big thing).

kaje (M), *n.* a child, = kazi; ipĭkai-kaje, a girl; mŭgi-kaje, an infant; nêtur-kaji, a son.

kak (N), the framework on which a corpse was dried. Cf. sara.

kakal *v.* to appear (?); noi kulai kakal Marialpa adapadan, he appeared first to Mary. Mark, xvi. 9; palamulpa kakal adan, appeared to two.

kakera (Mg), *n.* tortoise-shell.

kaki (N), *exclam.* I say! Look here! Cf. kawki, kami, komi.

kakiam (Mb, B), *n.* the bird of Paradise.

kaku,

kakur, *n.* an egg, ovary of a fish; the testicles (M).

kakura, kakurö, *n.* the feet.

kakurupataean, kakurpataean, *v.* to step across; *prep.* across; tana muasin tarödan kakurupataean, when they had passed over. Mark, vi. 53.

kal, kala, kalö, *n.* the back; the hinder part; the outside. Mark, viii. 15; (M), the back of the hand; kalapa, at the back, behind; kalanu, after that, then.

kalak, kalaka, klak, *n.* a spear (333); or rather a javelin, as it is thrown with the kubai.

kalakala, *n.* a fowl.

kalakönitu = klak-nitu.

kălapi (M), *n.* a large bean, = kulapi, "the produce of a vine-like creeper with legumes a foot in length, eaten with biiu." Macgillivray, ii., p. 27.

kalemel = kalmel.

kalmel, *ad.* or *n.* together. [kalmelpa.]

kalmel-mönamöin, *v.* to unite.

kalmel-uzar, *v.* to accompany.

kalum-rida (M), *n.* the collar bone.

kalupi,

kamadi (M), *n.* a belt worn obliquely across the chest, made of young coco-palm leaf. Cf. naga.

kamadö (B), *n.* a necklace.
kaman (M), *n.* heat, steam.
kamănale (M), *a.* warm.
kama-tauradiz, *v.* to nurse.
kami (M), *a.* dear (used by a female to a male, see **kawki**).
kamikamö (B), *n.* ringworm.
kamizingi, **wur kamizingi**, flood tide.
kămu (MG) *n.* the body, = gamu.
kamus *n.* another name for the Maiwa ceremony.
kangu (M.) *n.* a frog. (Pronounced kang-gu).
kanguru (?); **kanguru-pagamoin**, *v.* to be spread abroad (?).
kap, *n.* a dance. See kab.
kape (M), good, pretty, = kapu.
kape-ganule (M), sweet, fragrant (lit. possessing a good smell).
kape-parure (M), *a.* pretty-faced.
kap-garig, *n.* name of a dance. Cf. garig-kap.
kapi, *n*, the thigh; the legs (MG).
kapi-kĭsuri (M), *n.* moonlight.
kapi-taig (M), *ad.* a long way off.
kapu, *a.* good, beautiful.
kapu, *n.* seed; tomi kapu, timi kapu, small red and black seeds, (crab's eyes).
kapua,
kapua kasiginga, **kapuakösiginga**, *n* unbelief; *v.* not to believe.
kapua kasilai, *n*, faith. Mark, v. 34.
kapua kasin, *v.* to believe; *n.* faith, hope. [kapuakamoin].
kapuka-tete, *n.* the west; kapuka = kibuka.
kapukuiku,
kapu-minar, *a.* best (lit. good mark, probably a phrase adopted from the mission schools).
kapu-mitalnga (B), *a.* edible (lit. possessing a good taste).
kaputo, *n.* the other side (of a river). [kaputopa].
kapuza = kapu za.
kar, *n.* a fence; bĕribei kar, a rope fence.
kara (MB), name of a tree; the raw fruit is eaten in the initiation ceremonies (398).
kara (M), = kai, köi.
kăraba (M), *n.* a paddle, = kaba.

karăbai (I), *n.* an egret, = karubai, karbai.
karaba-tapeipa, *v.*
karăb (MG), *n.* nostril.
karăbu (M), *n.* nostrils.
karaig,
kara-malupa (M), *ad.* a long way down.
kara-nagri (MG), *ad.* enough. (Stone).
karar, *n.* the shell of a turtle.
karar-asin, *v.* to like, to obey.
karauaig = korawaig.
karawaigö = korawaig.
karbai, *n.* an egret; karbai ial, karbai plis, or kaikai, feathers of the egret; (M), the blue heron.
kăreki (M), *ad.* hereabouts. Cf. kö, of which the (M) form would be köre.
karengaigö, *a.* not hearing.
karengemin, *v.* to hear, to listen, to obey. [karengemiziu.]
karget (M), *n.* little finger. (Jukes.)
karingi (T), *n.* a lad during the initiation ceremony. Cf. kĕrnge.
karmiu, *n.* name of a fish, = karmoi.
karmoi (M), *n.* a fish. *Scatophagus multifasciatus.*
karomat (M), *n.* a brown snake.
karta (M), *n.* the throat, = katö.
karubai (M), *n.* an egret.
karudan (T), *n.* a shell frontlet, a drum pattern.
karum (T, S), *n.* the monitor lizard, *Varanus*; called "iguana."
karumatapi, (karum swimming) *n.* a dance (362).
karuma-gam (T), *n.* the skin of the monitor.
karuma-güngau (M), *n.* the skin of the monitor.
karum-palan (?), betrayed. Mark, xiv. 41.
karusa (MG) = kaura.
kăsa (M), *n.* the bed of a stream, a river. Mai Kasa, Wai Kasa, names of rivers in New Guinea.
kasa, *n.* the pandanus. Cf. kausa.
kasa, *v.* to lend.
kasa, *ad.* only, just.
kasa iagiasin, *v.* to be quiet.
kasa-tabu (B), *n.* a harmless snake.

kasa-kupal, *a.* naked.
kasa-paibanö (B), *n.* a present, gift.
kasa-wanan, *v.* to forsake, to leave alone. Mark, xv. 34.
kasigig, *a.* childless. Cf. **kazigiṅga**.
kăsur (M), *n.* a salt water creek. Cf. **kasa**.
kat (Mb), *n.* neck.
kata-kazi (B), *n.* twins.
katam, *n.* a bunch, a crowd.
katamö, *n.* a banana.
katamiz, *a.* narrow.
kata-plagis (B), *ad.* upwards. See **kat-palagiz**.
kata-pulgeipa (M), *v.* to jump, to leap.
katauoi (T), *n.* the green parrot.
kateko (B), *n.* a frog.
katö, (*n*), the neck, throat.
kat-palagiz, *v.* to escape, leap. [**kadrö palagiz.**]
katramizö = **katamiz**.
katrö = **katö**.
kaua = **kawa**,
kauburu (S), *n.* a gourd.
kaubasin, *v.* to strain, labour; noi iman tana kibu kaubasin kaba nitun, he saw them toiling in rowing. Mark, vi. 48.
kaukwik (Mb), a young man; the ceremony on arriving at puberty (405). Cf. **kernele**.
kaukwoiku (M), *n.* a young unmarried man after initiation.
kaura (M, Mb), *n.* the external ear.
kaura, *n.* the nautilus.
kaura (M), *n.* an island = **kawa**.
kaura-apusö, *n.* the ear hole; ieudan ukasar dimur a ukasar kaura apusö utun nubepa, put his fingers into his ears. Mark, vii. 33.
kaura-kikire, *n.* the ear-ache.
kauralenga, *a.* possessing ears; ita muamuai kauralenga, the deaf.
kaurare (M), *a.* possessing ears; wati-kaurare, deaf (having bad ears).
kaura-tarte (M), *n.* a hole in the lobe of the ear.
kauru (M), *n.* the laughing jackass.
kauruta (M), *n.* bunions.

kausa, *n.* fruit, seed, nut, = **kōusa.**
kausa, kausar, (M), *n. Pandanus pedunculata.* Cf. **kasa.**
kausi (T), *n.* a hawk. Cf. **kudzi.**
kausur (M), *n.* a flower.
kautŭri (M), *n.* a blue crab.
kawa, *n.* an island; people; **iau kawa**, *n.* a market. [**kawapa.**]
kawakawal, kawakawial, *n. pl.* islands, nations. [**kawakawapa.**]
kawakuig, kawa-kuikö, *n.* a young man. Cf. **kernele.**
kawki (M), *a.* dear (used by a male to a female); see **kami.**
kawp (M), *n.* a seed.
kawruta,
kazi, *n.* a person, a child; **niai kazi**, *n.* a scholar, a disciple (lit. a sitting person); *pl.* **kaziel, kazil.** [**kaziu, kazipa, kazingu, kaziae.**]
kaziginga, *a.* uninhabited (lit. child not possessing).
kazilaig, *a.* having a child. Mark, vii. 25.
kaziöl, *pl.* of **kazi.**
keda, *ad.* thus, as, saying; a word introducing a quotation.
keda, *v.* to be like, to resemble; **keda aiginga**, *v.* to differ.
keda (M), *v.* to cut.
kedamizin,
kedangadanga, *n.* length.
kedangadal, kedangadalnga, *a.* like, like this; **noi kedangadalnga umangange**, he was as one dead. Mark, ix. 26.
kedawara, kedazingu, keda-zinguzö, *conj.* for this cause, therefore.
kedazou (?), *conj.* for; **kedazou mai Joane iamuliz Heroda**, for John told Herod. Mark, vi. 18.
kedazöngu (s), because (lit. from the thing thus).
kedazöpa, *conj.* therefore (for the thing thus).
kedazöpuzigöpa (?), **kedazöpuzigöpa nidaipa**, (who) had done thus. Mark, v. 32.
kegoba,
kei = **kai, köi.**
kei-gălein (M), *a.* dumb.
kei-gariga (M), *n.* noon-tide (lit. big sun).
ke'ipĭkai (M), *n.* an old woman, = **kai-ipiki.**
kei'kuku (M), *n.* the great toe.
keimăgi (M), *n.* an associate, a friend. Cf. **kernele.**

keinga (M), *a.* large; *ad.* very, = **kai, köi.**
kekêdi (M), *a.* gorged.
kekeri, *n.* a bird with red breast.
kekermisina (?), **purka kekermisina** (B), *n.* ophthalmia.
keki (M), *n.* a gull.
keköchipa (M), *v.* to forget.
kemus = **kimus, sabu kemus,** *n.* a needle.
ke-pramek,
kerer (M) = **kerer.**
kererki, *n.* the name of a star. Cf. **garig kap.**
kêrisa (M), *n.* the blue mountain parrot.
kerkatö = **kêrkêt.**
kerkatö-palan, *v.* to torment.
kêrkêt (M), *n.* anger, rage.
kerketale (M), *a.* vindictive, furious.
kĕrketegerkai (N), *n.* a warrior. Cf. **kaigerkitalgaka.**
kernele (M), **kĕrnge** (N), a lad who is being initiated into manhood. Cf. **karingi, zungri, kaukwik, keimagi** (405, 409, 433).
ketai, *n.* a yam (*Dioscorea*). Cf. **kutai.**
ketal (M), *n.* a thread.
ketekete,
keuba-tati, *n.* uncle (lit. **tati,** father, **keuba,** perhaps for **köpa,** a little way off).
keusa, *n.* fruit, = **kausa, köusa.**
ki (M), an affix of emphasis. Cf. **kai.**
kiamusa (B), *n.* the point of an arrow, = **kimus.**
kibu, *n.* the loins, the lower part of the back; **padau kibu,** the slope of a hill. Mark, v. 11.
kibuka (**kibupa**), *n.* a mythical island to which the **mari** of deceased persons go (318). "Hades."
kibu-mina, *n.* a totem cut on the small of the back of a woman (lit. loin mark) (368).
kicha (MG), *n.* the sun, the moon. Cf. **kisuri, kizai.**
kida (M), *a.* left.
kidakida-nagepa, *v.* to gaze.
kidakidan (?), **tana kidakidan ia uman,** they said among themselves.
kidö (?),
kidö-taean, *v.* to turn, to overthrow; see **kita-toeailai.**

kidu-waru (MB), the finish of the turtle (surlangi) season.

kikimizi,

kikira,

kikir, kikiri, *n.* disease, pain, affliction; *a.* sick, ill; **kikiri-laig,** *n.* a sick person; koiku-kikiri, headache; dang kikiri, toothache; kaura kikiri, earache.

kimus (S), *n* an arrow.

kin (MB), *n.* a creeper used in making makamak.

kirer, *n.* an artery, a vein, a sinew.

kirkup, *n.* a nose ornament. Cf. gigu.

kisigan (MG), *n.* a mountain. (Stone).

kĭsuri (M), *n.* the moon.

kita-töeailai (?) to be converted. Mark, iv. 12. See kidö-taean.

kizai (S), *n.* the moon.

klak-nitu (S), **klak-nĕtoi-gĕt** (MB), **kalakö-nitu,** *n.* the index finger; the number four in counting on the body.

kö, *n.* a place near, a little distance. Cf. kareki. [köu, köpa, kozi.]

koakan, *a.* round.

koam = kaman, kuamö, fever. Mark, i. 31.

koamala-nagiz,

köamapa, *v.* to warm oneself; nadö Petelun iman muingu köamapa, she saw Peter warming himself.

koamasin = kuamö, asin; körkak koamasin, sore amazed. Mark, xiv. 33; gamu koamasin, *n.* fever (lit. with hot body).

kob (N), *n.* the tail of a dog. Cf. kouba.

koba (M) = kob.

kobai (M), *n.* the throwing stick (334). Cf. kubai.

kobai-ngur (MB), *n.* the peg or hook of the kobai.

kobai-piti (M), *n.* the peg of the throwing stick. Cf. ngurr.

kobaki (M), *n.* a cough.

kobaris (M), *a.* unripe, uncooked.

kobebe (MB), *n.* a bird (Legends, p. 29).

kobegada, *a.* this kind. Mark, ix. 29.

kobi (N), *a.* black.

köbia (?), tana ladun a maumizin köbia gulugul, they went forth and preached everywhere. Mark, xvi. 20; noi gurugui uzar köbia gurugup ngurupaipa, he went round about the villages teaching. Mark, vi. 6.

kobikobi (T), *n.* the charred shell of the coconut, charcoal; kobikobi marukai *or* gŭmŭle (M), black men. Cf. kubi.
kobikobigămol, kobikobigŏmŏla (T), *a.* black. Cf. kubikubinga.
koboi-nguru (MB), *n.* the hook of the kobai, = kobai-ngur.
kobu, *n.* war, enemy, battle, = koubu.
kŏbura (B), *n.* a lime gourd. Cf. Mir. kabor.
kodal, *n.* a crocodile, = kudal.
ködu, *n.* a part.
kogwoi (M), *n.* the throwing stick. Cf. kobai.
köi, *a.* large, great, big; *ad.* very, = kai, kei.
koi-aböu (koi-iaböu), *ad.* with a loud voice.
koi-ad (S), *n.* an anchor.
köi adumeipa, *v.* to rave.
köi-gakazi (S), *n.* a chief.
koigaraka, *n.* a chief.
koi-gĕrza = köi-görsar.
köi-görközi, *n.* a chief; köigörközi wakaiauiamoin, chief priests. Mark, xiv. 55.
köi-görsar, *a.* many.
koi-ia, *a.* loud (lit. big voice).
koiko-dĭm (S), *n.* the thumb (lit. head-finger).
koik-patan = kuikö-patan.
koikoro, *n.* a head-dress worn by young men, a pattern on a drum.
koiku (M), *n.* the head = kuikö.
koiku-kikiri, *n.* head-ache.
koikutalnga, *a.* long, high, tall (having big ends).
koim, koima (S), *a.* many, much.
köi-magaulnga, *a.* strong.
koi-magu, *n.* a bunch.
koimai (T), *n.* the scarified mark on the shoulder.
koi-maita (B), *n.* the gizzard of a fowl (lit. big stomach).
köi-malu, *a.* deep (lit. big sea).
koi-mapu-bodali, *a.* sick.
köi-mapunga, *a.* difficult, heavy (having great weight).
köingar, *n.* elephantiasis of the leg (lit. big leg).
köi-ngona-poidan, *v.* to sob.
koiop, = kuiöpa.
köi-pui, *n.* a log (lit. big wood).

köiridanga, köiridangö, *a.* hard (lit. very bony).
köisarköisar (?), Pilato köisarköisar korkak banitan sisike noi umanga, Pilate marvelled if he were already dead. Mark, xv. 44.
köisigal, *a.* far, remote; köisigapa, *ad.* afar, to a distance.
köi-sigazi, *ad.* from afar.
koi-wamen-udiz (S), *n.* ebb tide.
koi-za, *a.* big, large, great (lit. large thing).
koi-zarasan.
kokam, kokan, *n.* a ball.
kökaper, *n.* a spark.
kokata (M) = kwokata.
koki (M) = kuki.
koki, *n.* the season for turtle feasts. Cf. kuki.
koko (M), *n.* the foot. Cf. kakura, kuku.
koko-geta.
koko-kaleri (M), *n.* the sole of the foot.
koko-moi (M), *n.* the sole of the foot.
koko-moka (M), *n.* the sole of the foot.
kola (M), *n.* a rock, = kula.
kolab (T), *n.* the shoulder-blade, or scapula.
kolam (M), *n.* the shoulder-blade.
kŏlan (Mg), *n.* the shoulder.
koli (Mb), *n.* a paddle when used for steering. Cf. kuli.
kolkar, (M), *n.* blood, = kulka.
kolo (M), kolu (M), *n.* the knee, = kulu.
kömaköma (S), *a.* separate, opposed to; ngalpalpa kömaköma maiging, not against us.
komalenga, *a.* hot, = kuamalnga.
kŏmi (N), *exclam.* I say! Look here! (see kami, kawki, kaki).
könamiz, *v.* to spy.
kon, *n.* corn (English word corn); konau-apö, a corn-field.
konga,
konil, *n.* a bundle of arrows.
köpa. Cf. kö,
köpazi, an error for közipa. Mark, viii. 1.
kopêr (M), *n.* a tree.
kopi, *n.* the half, a lump.
kopuru (M), *n.* a fish, whiting (*Silago*).

kora (T), *n.* a crocodile, = kodal, kudal.
korabu (M), *n.* the septum narium.
korawaig, korawaigö, *v.* to be unable, cannot.
kŏrĕkida (M), *ad.* a long time ago.
körkak, *n.* the throat; the seat of the affections, the mind. [korkaknu korkakönu.]
korkakö-badö, *v.* to sigh. Cf. korkak, badö.
korkar (S), *n.* the mind.
korkor, (M), *n.* a crow.
körngaizinga, *n.* things heard. See korongaipa.
koro,
korongaigigo, *a.* deaf, = karengaigö.
korongaiginga, *v.* not to hear, = karengaigö, korongaigigo.
korongaipa, *v.* to hear.
koröka̋k = körkak.
körpusönga, *a.* tender; nongo tamo körpusönga, when its branch is tender. Mark, xiii. 28.
korsi, *n.* the hammer-headed shark (*Zygæna*).
köru, *n.* a corner. [körupa.]
korul, *n.* the heel.
kosa (MB), *n.* the sternum. Cf. dadir.
kösa, *n.* a river, = kăsa; kösa Ioridana, river Jordan; kösa Galilaia, sea of Galilee; mai kasa, Pearl River. Cf. native names of places.
kosi (?) = kazi. See next word.
kösiman, *v.* to rear, bring up.
kosiman (?), noi iautumizi tanamulpa nianö kosiman tana senabi imusö maludönga, he commanded them to make all sit down by companies on the green grass. Mark, vi. 39.
kota-dimu (S), *n.* the little finger.
kota-get (MOA), *n.* the little finger.
kotaig (Badu) = last.
kŏtale (M), *a.* long, high, tall.
köteko (B), *n.* a frog, = kateko.
koto-dimura (MB), *n.* the little finger; kotodimura gorngozinga (or guruzinga), the fourth finger.
kötuka (?), keda ngadalnga sinapi köusa a utun kulai sena mina kötuka mina köusa köiza ina apal, like a mustard seed which when it is first sown is less than all the seeds that be in the earth. Mark, iv. 31.

köu. Cf. kö.

kouba (S), *n.* the tail of a quadruped, = kob.

kouba (S), *n.* war, battle, an enemy.

kouba-laba (S), *n.* the tail of a bird.

köubu = kouba.

koulka (M), *a.* red. Cf. kulka.

koupapa (S) = koupupa. Cf. kouba.

koupupa, *n.* a warrior, a soldier.

köusa, *n.* fruit, seed, = kausa. [köusau, köusangu.]

köusalenga, *a.* possessing fruit; in Mark, xi. 13, a mistranslation for nisalenga.

közi, *n.* = kazi, *pl.* köziel. [köziu, közipa, közingu.]

köziginga, *a.* = kaziginga.

krabu (M), *n.* nostril.

krameipa (M), *v.* to steal.

krangipa (M), *v.* to hear, to understand, = korongaipa.

krar (M), *n.* a mask. Cf. buk.

krem (M), *n.* the white heron.

kris, *n.* a parrot.

kua,

kuai (M), *n.* a red berried *Eugenia*; the crown of the head.

kuamalnga, *a.* hot, warm (lit. possessing heat).

kuamö (B), *a.* warm (see kaman), hot; *n.* heat.

kuato,

kubai (B), *n.* a throwing-stick; a sling (Macfarlane). Cf. kobai.

kubaki,

kubi, *n.* charcoal, touchwood. Cf. kobikobi.

kubi (M), *a.* many, plenty

kubiger,

kubikubinga, *a.* dark, black.

kubil, kubilö, *n.* night, darkness; *a.* dark.

kubilu = kubilö.

kubirk (MG) = kobaki.

kuchi (M), *n.* a rattan.

kudal (S), *n.* a crocodile, = kodal.

kudapa = kutapa.

kudrugu, *n.* a small dove.

kudu, kudru, *n.* the elbow; the number 7 in counting on the body.

kudu (?); noi balbaigi iangu kudu taean, he spake plain. Mark, vii. 35.
kudul, *n*. the elbow, = kudu.
kuduman, *v*. to admit, to accede to. [kudumamain.]
kudzi-kwik (T), *n*. a carved wooden bird's (? hawk's) head for decoration of a canoe. Cf. kausi.
kugi (M), *n*. the young of sapur.
kui,
kuiai (?), kuiai torik, kuiai turik, *n*. a sword. Mark, xiv. 45, 47.
kuibur (?), kuibur torödiz, *v*. or *a*. tame.
kiŭīur (M), *n*. a mangrove.
kuik = kuikö.
kuika-iman, *v*. to begin, to commence.
kuika-longa = kuikulenga, etc.
kuik-gasamiz, *v*. to wail.
kuikö, *n*. the head; the skull.
kuikö-patan, *v*. to behead.
kuik-taean, *v*. to nod.
kuiku = kuikö; kuiku ipi, *n*. a chieftainess. [kuikupa, kukungu, kuikunu.]
kuiku, *n*. root. [kuikungu, kuikunu.]
kuiku-dimö, *n*. the thumb; the number five in counting on the body. See koiko-dĭm.
kuikui,
kuikuiga, *n*. brother. [kuikuigau.]
kuiku-kikiri, *n*. head-ache.
kuikukazi, *n*. brother.
kuikulenga, kuikulnga, kuikulönga, *a*. chief.
kuikulumai, *n*. a lord, a chief, master; kuikulumai vine apangu, *n*. the lord of the vineyard. Mark, xii. 9. [kuikulumaipa, kuikulumaingu.]
kuikulunga, *a*. chief. [kuikulungae.]
kuiku-öimo = kuikaiman.
kuikutanga (B), *a*. tall.
kuiku-waipa, *v*. to talk over to take counsel, usually with ia preceding. noi ia mura kuikö waipa tana mulpa, he expounded all things to them. Mark, iv. 34.
kuiöpa (B), *n*. the dragon fly.

kuisimi, *n.* height.
kuiur (M), *n.* the dart of the dugong harpoon (wap). Cf. kwiuro.
kuki, *n.* the West wind; the North West monsoon; the rainy season; winter; spring (Macfarlane). Cf. koki.
kuki-dogam (s), *n.* the West.
kuköpalan, *v.* to save (?), mi mabaeg nongo igilenga koi kuköpalan, whoever will save his life. Mark, viii. 35.
kuku (M), *n*, the foot, toes.
kukuama, *n.* a flower, a blossom; kukuamnge. Mark, iv. 28.
kukuiközipa, *dat.* of kuikukazi. Mark, xiiii. 12.
kukule (M), *n.* an elder brother or sister.
kukuna-mapeipa (M), *v.* to kick.
kukup (M), *n.* the buttocks. Cf. keep.
kukutalinga = koikutalnga.
kul (M), *a.* first.
kul (M), *ad.* two or three days ago; mata kul (M), *ad.* about a week ago.
kula, *n.* a stone, rock. [kulapa, kulanu.]
kula (N), *n.* flat stones with faces painted on them connected with ancestor worship (321).
kula (s), *a.* red.
kulai, *v.* to precede, to go before.
kulaikulai, *ad.* before.
kulai-tai, *v.* to advance, to go before, to pass by. [kulaitaiz.]
kulăle (M) = kotale.
kulăle (M), *a.* stony.
kulau-amai, *n.* lime (lit. oven of stone, *i.e.* burnt coral).
kulba, kulbang (M), *a.* worn, old from use, ancient.
kulbulo (B), *n.* an owl.
kuli, *n.* the steering board of a canoe; kuli-toidiz, *v.* to steer. Cf. koli.
kulka, *n.* blood; kulkale (M) *a.* bloody; kulkthung, *a.* red. [kulkau.]
kulkadagomola, *a.* red, blood colour.
kulka-ieudiz, *v.* to bleed, to pour blood.
kulkale, *a.* from kulka.
kulkau (s.), *n.* blood.
kulkuigau,
kulkulkuma (B), *n.* dysentry (lit. bloody excrement).
kulapi (M), *n.* a large bean, = kalapi.

kulpa (S), *a.* old, = kulba.
kulu, *n.* the knee.
kulu-damanu,
kuluka = kulka.
kulukal, *a.* red, purple.
kulukubö, kulukubu, *n.* a long time.
kulun-tariz, *v.* to bow the knee. Mark, xv. 19.
kuma, *n.* dung, excrement, rust.
kumakuma (S), *a.* secret. See kumi.
kumar (Mb), name of a plant used in the initiation ceremonies (399).
kumaskumas,
kumete, *n.* a bushel. From the Samoan 'umete viâ Lifu kumete.
kumi (S), *n.* a secret. Cf. gumi.
kun, *n.* the hinder part; gulngu kun, the hinder part of the ship. Mark, iv. 38.
kunakanange (S), *a.* strong, tough (of cloth).
kunamin,
kuna-poibiz, *v.* to groan, to moan.
kunarö (B), *n.* lime; mainö kunaran paruia nidizö, made mourning with faces of lime. Mark, v. 38. See Introduction to Saibai Grammar.
kunia (? from kun), noi ubigösia kunia onailai, he would not reject her. Mark, vi. 26.
kunia-tidiz, kunia-tridiz, *v.* to return.
kunumeipa (M), *v.* to tie.
kunur (M), *n.* ashes.
kuote (Mb), *n.* the back of the head.
kup (Mb), *n.* the buttocks. Cf. kukup.
kupa (M), *n.* a white berried *Eugenia.*
kupa (M), *n.* the hip; maita kupa *n.* navel.
kupadö, *n.* a bay.
kupai, *n.* a share, = kopi.
kupai (S) = kupor,
kupalabö (B), *n.* a tail.
kupal baba (B), *n.* a tail feather.
kupalenga, *a.* from kupar, ngau kupalenga, I pity; woe. Mark, xiii. 17.
kupa-luba (M), *n.* the tail of a bird.

kupar, *n*. the navel. Cf. Mir. kopor.
kuparö, *n*. a worm.
kupe (T), *n*. a medicinal plant.
kupor (s), the umbilical cord. Cf. kupa, kupar.
kupur, *n*. the navel.
kupuza = kapuza.
kupwa,
kurdai (T), *n*. a kind of native rope. Cf. kwodai.
kŭri (M), *n*. a gum tree. (Jukes.)
kurkagamulnö (B), *a*. red. Cf. kulka, gamu, kulkadagomola.
kursai (T), *n*. the ear, = kaura.
kursimi (s), *n*. a height. Cf. kuisimi.
kurtumiz *v*. to scratch; *n*. itch.
kurtur (M), *n*. a worm; (s), *v*. to crawl.
kuru,
kŭrugat (B), *n*. the post of a house.
kurusipa, *conj*. until.
kŭsa (B), *n*. a river. (See kăsa).
kusa, *n*. *Coix lachrymae*, Job's tear seeds, *pl*. kusal; (hence a bead); a belt made of these seeds (M); kusa duru (M), a bead band worn on the wig.
kusa kap, *n*. a mythical gigantic bird, born parthenogenetically from a woman. (Legends, I. 3.)
kusaig, kusaigö, *n*. self; *a*. alone.
kusal, *n*. a necklace (lit. beads).
kusali (M), *n*. the Pleiades.
kusu (MB, M), *n*. a coconut water-bottle.
kusu kusulaig (MB), *n*. a broom, the dance name of piwul (404).
kut, *n*. the neck.
kut (M), **kuta** (s), *n*. evening, afternoon, = kutapa. Cf. kutö.
kuta, *n*. the end, = kuto.
kuta-dimur, *n*. the little finger.
kutai (M), *n*. a fibrous yam (*Dioscorea*). Cf. ketai.
kutaig, *n*. a younger brother or sister; *pl*. kutaigal. Cf. kutö. [kutaigou.]
kutaigan-nge,
kutal, *n*. length.
kutalnga, *a*. long.

kutam (?), kutam titui, a species of hawk.
kutăpa, *n.* the evening. Cf. kut, kuta.
kutapatai,
kutau,
kutö (S), *n.* the end, extremity of anything; kabudan senabi pudau kutanu, put on the end of a reed. Mark, xv. 36.
kutöka (S), *n.* the end, = kutö.
kutra, *n.* evening, = kuta. [kutanu.]
kutrapa = kutapa.
kutuman = kuduman.
ku-u-rug (M), *n.* the ground dove.
kuza. Mark, ix. 5. Apparently a misprint for kapuza.
kuzi (T), *n.* a species of hawk.
kwai (M), *n.* top of the head (?).
kwaimai (B), *v.* to scarify, to cut the skin so as to cause a raised cicatrix. (366.)
kwăli (M), exclamation to arrest attention.
kwalamö (B), *n.* the shoulder blade. Cf. kolam, kolab.
kwăsur, (quassur Macgillivray) (M), two, = ukasar.
kwatela (M), *n.* the back of the head. Cf. kuote.
kwēăda (M), *n.* the gromets on the backstays of a boat.
kwig (T), *n.* the head or skull, = kuikö.
kwik (MB) = kwig; merkai kwik, a head-dress used in the funeral dance; kwik'uro (M) *n.* the general term for a fillet worn on the head. Cf. uro.
kwir (S), *n.* a fight.
kwitoaean (quitoaean), *v.* to lose.
kwiuro, *n.* the dart of a dugong spear "wap." Cf. kwoiŏro, kuiar.
kwod, *n.* the house set apart for men, or the open space in which sacred ceremonies take place. Mir. siriăm; taiokwŏd (T), *n.* the sacred meeting place for the initiation ceremonies (409).
kwodai, *n.* twisted native rope.
kwoiŏro (MB), *n.* the dart of a wap or dugong spear (351).
kwoikwig (B), first.
kwokata (M), *n.* a frontlet of coco-palm leaf.
kwual, *n.* a curlew.
kzöiöl = kaziel.

L, *suffix* denoting the plural of nouns.
labaipa (M), *v.* to cut. [laban, lapan.]
ladeipa (M), *v.* to tear.
ladiak (MG), *n.* a chief. (Stone.)
ladon,
ladu, *v.* to go. [ladun.]
laelö (?), kuikaiman tanamulpa waean mata ukauka laelö, began to send them forth two and two. Mark, vi. 7.
laga (M), *n.* dwelling place, hut, house. *pl.* lagal. [lagau, lagöu, lagapa, lagöpu, lagöngu, lagönu, lagia, lagonge.]
lagilaig (S), *n.* countryman.
lagö (S), *n.* house, dwelling-place, land. See laga.
lai, *suffix.*
laigö, laig (S), *n.* country, island, place.
laig, *suffix* denoting persons in a group, a clan, a sect, a tribe.
laka (M), *ad.* again, = lakö.
lakadanö (B), *n.* war.
lako, lakö, *ad.* more, again.
laköboi (B), *v.* to return. Cf. lakö, boie.
lakonge = lagönge.
lalkai (M), *n.* a lie Cf. ngölkai.
lalkeipa (M), *v.* to lie, to be false; piki lalkeipa (M), *v.* to dream.
lameipa (M), *v.* to copulate.
lapan, see labeipa.
laulau, *n.* a table (introduced from Samoa *viâ* Lifu). [laulauiu.]
launga (S, B), *a.* no, not; mata launga, *a.* absent.
laungamaiginga (?). Mark, ix. 38. Apparently the two negatives with adjective termination.
laungaman, launga, mani (S), *v.* to repudiate, to rebuke, to refuse. [launga mizin.]
le (M), a plural *suffix* to nouns.
le (M) = li.
leara, *n.* a species of cashew (*Anacardium*) (308).
leg (M), *suffix* denoting possession.
lenga, *suffix* to adjectives denoting possession.
li (MB, S, M), *n.* a basket made of the leaves of the pandanus.
liwak, *n.* the chameleon.
logi (M), *prep.* near, close to.

logö = lagö.

löia (B), *n.* the tongue. Cf. noia.

lŏkof (MB), *n.* medicine; sorcery. Cf. gouga, maid, and Mir. lukup.

lönga (S), *n.* colour.

longa (M) = launga.

lorda, *n.* the shell worn on the groin when fighting. Cf. alidan.

luba,

lubu (?). Mark, xi. 15, niai za lubu ngorotaran, overthrew the tables of the money changers.

lulko (M), *n.* a large palm (*Seaforthia*); a water basket made of its leaves.

lumadö (?), sana-lumadö (B), *n.* the instep.

luman (S), *v.* to seek, to search, to guess.

lunga (S) = launga.

lunuranö, *prep.* around.

lupalan, be of good cheer (?). Mark, vi. 50.

lupaliz, lupalizö, *v.* to be astonished, to marvel.

lupeipa (M), *v.* to shake.

lurug (M), *n.* the haunch bone.

luwaiz (S), *v.* to be cured.

luwaean (S), *v.* to shave.

Ma (B), *n.* a spider, a cobweb.

mabaginga (?), mekatia mabaginga, not shine abroad. Mark, iv. 22. Probably mabaeg with the negative *adj.* termination, not having men, where men are not.

mabaeg, mabaegö, *n.* man; *pl.* mabaegal; ngurpai-mabaeg, *n.* disciple; köi zöngu ubi mabaeg, one who covets. Mark, vii. 22. [mabaegau, mabaegöu, mabaegan, mabaegöpa, mabaegangu, mabaegengu, mabaegöngu, mabaegia, mabaegae.]

mabaegögi, mabaegöginga, *a.* deserted, having no men; mabaegögi lagö, a desert place.

mabaeg-purtan, *n.* a cannibal, man-eater.

mabagi = mabaeg.

mabarö (B), *n.* the windpipe.

mabetö, *n.* a baby.

mabi (M), *n.* the tail of a fish.

mabiag, *n.* man, = mabaegö.

mad, mada, *n.* pudendum muliebre.
madale (M), *a.* female (lit. possessing mada).
madi, *suffix*, by (Macfarlane).
madu (M, B), *n.* flesh; *pl.* madul, thigh (Macfarlane); hip (B); thigh (B); bru-madu (M), *n.* calf of leg; wapi madul, flesh of fishes. Mark, vi. 41.
madubö, *n.* a charm, an image or idol.
madugi (?). Mark, ix. 42.
madugö, *n.* a fine; *v.* to fine.
madu-paman, *v.* to start, be startled. [madu-pamemin.]
madu-pawizo,
mae (M), *n.* the bark of which daje is made.
mael, *suffix*.
mag (T), *n.* sweat. Cf. mörög.
magao (S), *n.* strength.
magaolnga, *a.* strong.
magĕda (M), *n.* hair of groin; guda magöda, *n.* moustache.
magi, magina (S), *a.* small; magina-kazi, child; magina-ipikazi, girl; magina-malil, a nail; magina turikö (B), tomahawk.
magisö (B) = magiz, *v.* to spew.
magi-tiom (S), *n.* boy; *pl.* magi-tiomal.
magiz, *v.* to vomit.
magö, *v.* to perspire; *n.* sweat.
magus (S), *a.* enduring. (Perhaps a MS. error for magao).
mai, *n.* pearl-shell; maidan, a pearl-shell eye inserted in a skull.
mai (S), *n.* sake; Herodian mai Filipon ipi nongo kutaig, for the sake of Herodias, his brother Philip's wife. Mark, vi. 17.
mai (S), a well, pool.
mai. *v.* to mourn; *n* tears. [maidö, mainö.]
mai-adan (S), maiadi (B), *v.* to weep, put out tears.
maid, maiid, *n.* sorcery. Cf. lokof, purapura.
maideg (I), *n.* a small grass petticoat, big in front and behind, imported from Mowat. Cf. Maiwas.
maidĕlaig (MB), *n.* a sorcerer.
maierchipa (M), *v.* to cry, howl like a dog.
maige (M), maigi (S, B), *v. imper.* don't! do not!
maiginga (?), Iesu nubepa kudu maiginga, Jesus did not allow him. Mark, v. 19.

maigu (s), blind; *v.* to shut one's eyes (b).

maiguma, maigumua, *n.* a blind man; senabi maigumau getö, the blind man's hand. Mark, viii. 23.

mai-id, *n.* sorcery, = maid.

maikö (b), *n.* widow.

maikuik, maikuikö, maikuika (b), = markuikö.

maingu,

mainguzi (s), *n.* birth; nongo mainguzi goiga, his birthday. Mark, vi. 21. Cf. mani (b).

maipa (s), *v.* to bring.

maipa (?) mipa ngidö ngona mina mabaega dö maipa, why callest thou me good? Mark, x. 18.

maita, *n.* the belly, stomach; bowels (b); koimaita (b), *n.* gizzard of a fowl; kai maitalnga (b), *a.* corpulent.

maita-iginga, *a.* hungry; *v.* to starve.

maita-kupa, *n.* the navel.

maitāleg (m), maita-laig (s), *a.* pregnant; *n.* pregnancy.

maitarun, *a.* filled with food. Cf. maita, irun.

maitui (?) tanamun puruka maitui, their eyes were heavy. Mark, xiv. 40.

maiwa (m), *n.* the great clam (*Tridacna gigas*).

maiwa (n), *n.* the performers at a ceremony during the wangai season. Of these there were two (magina and kaiza) who danced in front of a waus. (321.) Cf. kamus.

maiwas (t), *n.* a small leaf petticoat imported from Mowat, small in front. Cf. maideg.

maiwazo (mb) = maiwas.

maja (b), maji (m), *n.* a coral reef.

mak (m), *n.* a breakwind of bushes.

makamak, maka (m), *n.* narrow, circular, twisted leg ornaments, from one or two to thirty or more in number, worn round the leg just above the calf.

makasö, *n.* a mouse, a rat. Probably introduced.

makiam, *n.* a scream; makiam ieudan, wondered. Mark, vi. 51.

makikak = makamak.

makupui (b), *n.* a flag.

makuz (m), *n.* a mouse, = makasö.

mal (m), *n.* deep water, = malu.

mălakai, *n.* a word employed by the South Sea teachers for spirit, ghost, etc., *i.e.* merkai or markai, the r is changed into l, and a vowel is inserted between the two consonants.

maladugomola, *a.* sea colour, blue.

malapan (MG), *n.* the moon, = malpal.

malegui = malgui.

malegui (M), *v.* to fill (with a fluid).

maleguia-adan, *v.* to spring up, of plants; to put out a stem.

maleipa, *v.* to fill with a fluid. Cf. mal, malegui.

malgui (M), malegui, spring, autumn; *v.* to grow (S); *n.* blade of grass; a stem (S); a stalk; malegui kai palgin, a stalk will come up. Mark, iv. 32.

malil (S), metal; malil dibidib, brasen vessel. Mark, vii. 4, malil urukam, *n.* a chain.

malila (B), a fish spear.

malö (B), *n*, a passage in the reef.

malpal, malpel (S), *n.* moon.

malpamiz (?), tana ina gar malpaniz senabi zapunu, they that trust in riches. Mark, x. 24.

malthagamule (M), *a.* blue; sea colour. Cf. maladugomola.

malu (S), *n.* the sea. [malupa, malunu.]

maluda (B), blue,

maludönga, maludunga (B), blue, green (lit. sea colour); imusö maludönga, green grass. Mark, vi. 39.

malulonga,

malupa (M), *ad.* below, downwards; kara malupa (M), *ad.* far below.

mamain, *v. pl.* from mani, take; kudu mamain, they took counsel.

mamal, mamalenga, *a.* holy.

mamamoizinga, *n.* things taken.

mamu (S), *ad.* well, carefully; mamu-ngurpa, *v.* to perceive; mamu danal-pataipa, *v.* to take heed.

mamus, *n.* a chief or head of an island. This is a Miriam word and introduced. Cf. Mir. Voc.

manamoizinga, *a.* joined.

mana-rimal (S), *a.* few.

mang (M), *n.* a branch.

manga, *conj.* but.

mangaiginga, *v.* not to come.
mangemin, *pl.* of mangizö; kulai mangemin, overtook, overwent. Mark, vi. 33.
mangepa (M), *v.* to return. Cf. mangiz.
mangi, *v.* to come. Mark, ii. 20.
mangiz, mangizö, *v.* to come, arrive, to overtake. [mangeman.]
mani (s), *v.* to give, bring, take, fetch, remove.
mani, *suffix*, by.
mani (B), *n.* birth.
mani, *n.* money. An English word. [maniu.]
mani-angan,
maniginga, *a.* having no money. (mani = English money).
mapa (M), the gums. Cf. Daudai mapu, base, foundation.
mapar, *n.* the teeth (Macfarlane). Cf. mapa.
mapeipa (M), *v.* to bite.
mapeia (?) kukuna mapeia, (M), *v.* to kick.
mapetö (s), *n.* a baby, *pl.* mapetal.
mapu (M), *n.* weight; nongo korkak mapu poidiz, he was displeased. Mark, x. 14
mapule (M), *a.* heavy.
mapunga (s), *a.* difficult, heavy.
marama (M), maramö, (B), *n.* a hole in the ground, a grave, a pit; a well.
marama-teipa (M), *v.* to put in the ground, bury, plant, sow.
maramatiai-lagö, marama-töiai, *n.* a tomb. Mark, v. 2., vi. 29.
marama-toiaipa (s) = marama-teipa.
marap (M), marapi (M), marapö (B), *n.* a bamboo, = morap; a bow.
mari (M), *n.* pearl-shell; an ornament made of pearl-shell. Cf. mai.
mari, *n.* a spirit, a ghost, the soul, a shadow, a reflection; mario-kwik (T), a leafy mask used in the funeral ceremonies; *pl.* maril. [maringu.]
maridan (s), maridanö (B), glass, a mirror, a telescope; maridan dibidib, cup. Mark, vii. 4.
mari-gĕta (MB), (spirit hand), *n.* the person who watched a corpse during the first night after death to see if anything happened (402, 421).
marilaig (s), *a.* possessed.
m ariman (s), *v.* to pine away (lit. become a spirit).
mari-o-kwik, cf. mari.

markai, *n.* a spirit, a demon, a white man. Cf. merkai.
markei (M), *n.* a heavy cumulus cloud.
markuikö (S), *n.* a generation.
marökai = markai.
maruk, *n.* fowl (European). Probably introduced. Malay or Polynesian manu.
marukai (M), *n.* white man; kobikobi marukai (M) *n.* a black man.
masia-tödimisö (B), *v.* to smile.
māt (M), *n.* pumice; mata (MG), *n.* a stone.
mata (M), *ad.* always, constantly, still, only; a prefix expressing a continuance of the action of a verb.
mata (S), *a.* legal.
mata (S), *a.* equal, only; *conj.* but, for.
mata-bangal (M), *ad.* a week or so hence.
mata-döbura (S), *ad.* immediately, quickly, fast.
matadödalö (B), *ad.* inland.
matakazupa (S), *conj.* but.
matakeda (S), *a.* like to, similar.
matakul (M), *ad.* a week or two ago.
matalaunga, *a.* absent.
matama (S), to beat, strike; to kill. See matupeima.
matamari, *n.* a bruise.
matamiz,
matangadagidö (S), *a.* worthy, equal to, alike, same, even, uniform
matangadagidiginga, *a.* unlike.
matar, matarö (S), mataru (B), *n.* calm.
mater (? = mata). Mark, iv. ii.
matö, *n.* a joist.
matu (M, S), *n.* a whale.
matumeipa (M), *v.* to strike, to beat, to kill; umalisö matumeipa (M), *v.* to wound.
maumisinö (B) = maumizin. [maumizineka].
maumizin (S), *n.* preaching.
maura (M), *n.* a hundred. Cf. mura.
mausa-usal (M), *n.* a scarified mark on the cheek (367).
mauwaigĕrk (N), mauwaigĕrko (T), the instructor of a lad during the initiation ceremonies (411).
mawagö-laig (S), *n.* adultery.

mawcha (m), *n* saliva. Cf. Mir. mos.

maza (m), *n*. the palm of the hand or the sole of the foot. Cf. kokomoi.

mazan (t), *n*. reef.

mazar (?), Mark, v. 15. mazarpagan, mazarpagizö, sore amazed.

meakata (b), *a*. bright. Cf. meketia, mekata.

meamai (b), *v*. to go in.

meamaipa, *v*. *pl*. to do.

meamöipa, *v*. have done (*pl*).

mee (mg), *n*. heaven.

megi (mg), meik (t), *n*. white.

megö (b), *n*. a lime spatula.

meipa (m), *v*. to take away.

mek (t), *a*. white, = meik.

meka (s), *v*. to wish.

mekata (s), *n*. radiance. See meakata, meket.

mekatasin, *n*. glory. Mark, x. 37.

mekatia = meket, meketia.

mekenmepa, *v*. to like, to wish, to want. Cf. mokenmepa.

meker (m), *n*. a tree (*Heritiera*). The leaf, when rolled in to a cylinder, is used to distend the lobe of the ear.

meket, meketia (s), *v*. to shine. Cf. meakata, mekata.

mekikula (mg), *n*. a canoe (Stone).

melpal (mg) = mülpal.

memain, *pl*. of mizin. Mark, vi. 32, 33; viii. 10.

menarö (m) = mina.

menir (m), *n*. the stern of a canoe.

mepa, *v*. to do.

mepaia, *n*. the world (?); mepaiangu mai, for the world's sake. Mark, iv. 17.

merkai, *n*. a white man (m), a spirit, the death dance; the flesh of a corpse (mb); merkai mud (mb), the store-house of a maidelaig; ipika merkai (mb), a man in the dance dressed as a woman (403); merkai kwik (mb), the head dress used in the dance (403); turkiam merkai (n) (421). Cf. markai.

mēt, *n*. a fin.

mi, *prefix*, the root of miei or midö, used as an interrogative. Cf. migöiga, miza, mimabaeg.

miai (B) = miei.
miăkula (M), *a.* grey; any light tint; miakali (MG), *n.* white.
mida-kubi (M), *ad.* how many?
mideipa (M), *v.* to build, as a hut. Cf. möidai.
midö (M), *pron.* what? which? how? in what manner?
midöparu, *ad.* how? (Macfarlane.)
miëi (S), *pron.* what? [miëinge. Mark, viii. 36.]
miëimiëi (?), *pron.* which of two? what? whether?
migöiga, *ad. interrog.* when? what day?
milagnu, *ad.* where? in what place?
milo,
mimabaigö (B), what man? who?
mĭna (M), *a.* perfectly good, true (S, B); mīna (M), *a.* precious, right; *n.* truth; tusi mina, Bible; mina get, right hand.
mina, minar, *n.* a mark; susu mina (M), on the breasts; kibu mina (M), on the loins (367).
minai-pataman (S), *v.* to confess, to show.
mina-man (S), *v.* to measure, to span; *n.* an example.
minananga (S), minanenga, *a.* righteous, holy.
minar, *n.* colour (Macfarlane).
minara (T) = mina.
minapa (?), ngalpa Augadan baselaia mi ngadalnga minapa, we liken God's kingdom to what? Mark, iv. 29.
minara-pölai, minarö-pölai, minar-palai, *v.* to cut or make a mark, to write.
minarpölaiginga, *v.* not to write.
minasizinga, *n.* a custom; *v.* to accustom.
min'azipa (M), *v.* to finish, said of men's work.
mineipa (? *v.* to mark); kaba mineipa (M), *v.* to dance.
minera = mina; tru minera (T), *n.* a mark on the side of the face.
minga (S), *pron.* what?
mingadalnga, *a.* like what? of what kind?
mingu, *ad.* why?
minguzö, *ad.* why?
mipa (M), *ad.* why?
misai (S), *ad.* yes.
mita, mitö (S), *n.* sweetness, taste; mita poitom (S), *a.* brackish.
mitaiginga (S), *a.* sour, tasteless.

mităle, mitalenga, mitalnga, *a.* sweet, tasty; g'ru tha mităle (m), *a.* sweet tasted; adabada mitalnga (b), *n.* brackish water.

mitinit, *n.* a chain.

mitö (m), *n.* taste. Cf. mita.

mitun,

miza, *interrog. pron.* which? what thing?

mizin (s), to sail; tana gumi mizin inabi gul, they departed by ship privately. Mark, vi. 32.

moa,

moaizinga, *n.* an ulcer; *a.* impure.

moamai (?), moamai kauralnga, *a.* deaf.

moamoa (s), *a.* eminent (man).

moamu (s), *n.* art. Cf. muamua.

möbalmöbal (?), möbalmöbal palan, *v.* to pluck. Mark, ii. 23.

modobaig. Mark, xii. 21.

modabia, modobia (s), *v.* to answer, to pay; to punish; to pay the blood price or were geld.

modobigal (? the fellow answering); uka modobigal, three. Cf. numerals in Grammar.

moeai, *v.* to enlarge.

modobigipa, *v.* to be unrewarded; modobigipa launga nubepa, he shall not lose his reward. Mark, ix. 41.

mögi-bötainga, *ad.* in the morning, long before day. Cf. mŭgi bateing (m).

möi (b), fire, = mui; moi i asimĭs (m), moi i usimi (mb), a stamping dance (362).

möidai, möidan, *v.* to build; lagau möidai mabaeg, builder. Cf. mideipa.

moidemin, *v.* to prepare.

möiga (?), ngalpa möiga kaziöl, is on our part. Mark, ix. 40.

moigi (s), *n.* dawn. Cf. arö.

moi-id (t), *n.* an eruption of pimples.

moilmoil, *ad.* sadly; *a.* grieved.

moin, *pl. suffix* to verbs.

moi-nitun, *v.* to float.

möken (s), *n.* want.

mokenmepa, *v.* to wish, to want.

mölpalö (b) = mulpal.

mönamöin, *a.* joined together, united; kalmel mönamöin, *v.* to unite (Macfarlane). Cf. manamoizinga.
mōōsa (B), *v.* to expectorate. Cf. mos.
moosö (B), *n.* the lungs.
mopa (?), mani mopa körupa, made head of the corner. Mark, xii. 10.
morap (T), mŏrap (S), *n.* bamboo; sukub-morap (M), sukubu-morap (T), *n.* a native bamboo tobacco pipe.
morbaigorăbĭnĭ (M), *n.* the name of a fish (Legends, II. 180) (? the jumping-fish, *Periophthalmus*).
möri = mari, *pl.* möril.
mörilaig, *a.* possessed; watri mörlog, possessed with an evil spirit. Mark, vi. 7. [mörlogia].
mörimal, *n.* & *v.* lean.
mörlogia. See mörilaig.
moro (M) = muru.
möroigö, *a.* old, aged, of persons only; *pl.* moroigal. Cf. kulba. [moroigau, moroigöu, moroigan.]
mortu (T), a house.
mos (B), *n.* spittle.
mos-aladiz, *v.* to spit.
mosan (?), mosan bauka, mosöbauka weidaman, *v.* to foam. Mark, ix. 18, 20.
mösial (?), noi mösial piöbizi, he marvelled. Mark, vi. 6.
mowiga (S), *n.* an elder. Cf. möroigö.
muamu, *n.* knowledge, wisdom.
muamuagigal, *a.* without understanding.
muamuai = moamoai.
muasin (S), *ad.* after; *v.* to finish; *conj.* then, when.
mubia (?), Mark, iv. 15.
muchi (MG), *n.* hair. Cf. Mir. mus.
mudamudö, *a.* crowded (?). Mark, ix. 14.
mudö (S), *n.* a house, dwelling place; village (B).
mudö (S), *n.* a multitude.
mu,
mue (M), *n.* firewood, fire; mue-kemeipa (M), *v.* to kindle a fire.
mudu (M), *n.* a camp. Cf. mudö.
mudul (M), mudula (B), *n.* the neck.
mue-daje (M), *n.* a small petticoat, worn by women.

mugara (T), *n.* a large fish called "barracoota" by the settlers.
mŭgi = magina; mŭgi kazi, mŭgi kaje (M), a child; mŭgi kalakala, chicken. mŭgi bateing (M), morning.
muging (M), *a.* small, few, a portion of. Cf. Mir. mog.
mugu, *n.* termites; the mound of termites (M).
mugu (B), *n.* a remnant. Cf. Mir. mog.
mui (M), *n.* the inside; muia utizö, muia utem, *v.* to enter (S); mui teipa (M), *v.* to put inside, to hide, conceal; muinu, *prep.* inside, within; mui-ariz, *n.* a redoubt, refuge (Macfarlane).
mui, *n.* fire, a fire brand. [muiapa, muitái.] Cf. mue.
muia-utiz, *v.* to enter in, to go in. [muia-utemin.]
mui-ilinga (S), *a.* square (possessing an inside).
muile (M), *a.* hollow.
muingu (?), muingu trapot, *n.* the pelvic fin.
mui-teipa (M), *v.* to put inside; mui taean, to charge. Mark, ix. 25.
mui-wazo (Mb), *n.* the smaller under leaf petticoat.
muki (Mg), *n.* water. Cf. nguki.
mukmepa, *a.* and *v.* loose.
mukö (S), *n.* rock, stones. Cf. kula.
muku-boidan (B), *v.* to fasten; to tie a thing. Cf. dorodimoin.
mula,
mulai (S), *v.* to speak. [mulailai. Mark, viii. 30.]
mulaigi (S), *v.* not to speak; *n.* nothing (i.e. no words).
mulagia = mulaigi.
mulaiginga, *a.* not to speak.
mulaigö (B), *v.* = ngulaig, to know.
mulaizi (?), nongo mulaizi ia, his oath (? word). Mark, vi. 26.
mulaka (S), *ad.* down.
mulepa (M), *v.* to speak, tell. [muliz, mulemipa, mulai, mulan, iamuliz, mulailai.]
muli (B), *v.* to answer, reply.
mulizö, *v.* to speak, to talk.
mulngu, *suffix* to plur. pron. from.
mulpa, *suffix* to plur. pron. to, for.
mŭlpal (M), *n.* the full moon.
mulpange, *suffix* to plur. pron.
mulsipa (377).

mulupa (S), *ad.* down; *v.* to descend.
mumugu-sigaman (?), see wakai mumugu-sigaman.
mun (S), a suffix to plur. pronouns forming the possessive case.
munia, suffix to plur. pron.
munia (S), *suffix* to plur. pron. with, have.
mura (S), *a.* all, entire, whole; mura-urui, *n.* insect.
murar, (MG), *n.* a clay tobacco-pipe.
mura-wardan (B), *n.* warrior.
murda-gamulnga (B), *a.* yellow.
murda umaizi (T), *n.* a plaited string.
mŭri, see Legends, p. 180.
murimari (T), poor, lean.
muro (M) = mura, all.
muru (M), *n.* the cabbage palm. *Corypha.* See moro.
mŭrŭg (M), *n.* sweat. Cf. magö.
musi (B), *n.* a piece.
musiginga (?), tanamun korökak musi ginga, have no root in themselves. Mark, iv. 17.
musĭ-teipa (M), *v.* to scratch, pinch.
musu (M), *n.* a green ant.
musur, musurö, *n.* armlets; plaited bracelets.
mutalö (B), *n.* a young coconut with water and no kernel.
muti, *n.* an ear-ring; the pendulous portion of the ear.
mutu (?), mutu trapot, the pelvic fin. Cf. muingu.
muzu, *n.* termites. Cf. musu, mugu.
muzura (S) = musur.

Na, *pron.* she.
na, *n.* a song, hymn.
nabepa, *pron.* to her, for her.
nabi, *ad.* now, at present, this; nabi göiga, to-day.
nabi-gĕt, ina nabigĕt (M), *a.* five; nabiget-nabiget, ten.
nabikoku (M), fifteen; nabikoku-nabikoku, twenty.
nabing (M), *a.* this, these.
nad = neĕt.
nadalai, *n.* the hair of the groin.
nadamai (B), *v.* to chew.

nadan (?), ngai ngita mulpa bami nadan kurusipa midö? how long shall I suffer you? Mark, ix. 19.
nadö, *pron.* she.
nadu (S), *pron.* her.
nadu (M), *n.* a grass tail.
nadual (Mb) = nadur.
nadulza (T), *n.* the hair on the pubes. Cf. nadalai.
nadur (M), *n.* a tail ornament worn in a dance, = nadual.
naga (M), *n.* a belt worn obliquely across the chest. Cf. kamadi.
naga (S), *ad.* where?
nagai,
nagalăg, *n.* a hawk, the sea-eagle.
nagalug, *n.* a hawk, = ngagalaig.
nagapa (S), nagepa; *v.* to look. [nagemipa.]
nagemiu, *exclam.* behold! look! See nagiz.
nagemilu,
nagepa, *v.* to look. [nagiz, nagemipa, nagemiu.]
nager (M), = naga.
nagiz, nagizi, nagizö, *v.* to look, to stare.
nagö *ad.* where?
naïi, *n.* the tongue, = noia.
naidai, naidai-dogam (S), *n.* the north.
naigai (B), *n.* the north.
nainanope, nainonob, nainonop (together?), thörte nainonop, thirty fold. Mark, iv. 8, tana nainanope uzar nubepa siëiki, they came to him from every quarter. Mark, i. 45.
naipuisö (B), *v.* to lick.
najeronajero (T), *n.* the dodder (a pink climbing parasitic plant).
nakareipa (M), *ad.* above, upwards.
nalaga, *ad.* where? which?; köiza nalaga senabi sabi? which is the great commandment in the law? Mark, xii. 28.
nalagazi, *ad.* whence?
nalagi (S), *pron.* which?
namoit, *ad.* when? (Macfarlane.)
nana,
nanimiz, see garo-nanamiz; tana nanamoin, they consulted.
nanga, a *suffix.*
nangap, *n.* the north; pin nangapa, *n.* the south (Macfarlane).

nanitna (S), *v.* to run, ran; *a.* erect.
nanu, *pron.* her, hers.
nanue (M) = nanu.
nanuz, *pron.* from her.
nanuza, *pron.* her thing, hers.
napa, (Mg), *v.* to bring, = ngapa.
na-poidan (S), *v.* to sing; to laugh.
nar, (Mg), *n.* foot, = ngar.
narang (M), *n.* the armpit; narang sŭka (M), the hair of the armpit.
narangi,
narberit,
narminamis, *n.* a moth.
nataizinga, *n.* a thing that is burnt; senabi mura gudataean natizinga, all whole burnt offerings. Mark, xii. 33.
natam (M, Mb), *n.* a namesake; *v.* to change names with another.
natiz, natizö (?), white. Mark, ix. 3; ngita ugulaig amadan dökal natizö, ye know that summer is nigh. Mark, xiii. 28.
nau (S), *n.* hymn. Cf. na.
naur (M) *n.* the peg of the kobai or throwing stick (334). Cf. ngurr.
ne (S), *pron.* his.
neĕt, a dugong platform (351). Cf. nad.
negal (?), ina mura demoni negal iapa, suffered not the devils to speak. Mark, i. 34.
neipoiz, *v.* to lick.
nel, nelö, *n.* name. [nelpa.]
nele = nel; Iesun nele adaputiz, Jesu's name was spread abroad. Mark, vi. 14.
nelea (?) = nel. Mark, vii. 2.
nelenga = nele, nga.
nelginga (S), *a.* fameless (lit. not having a name).
nep (M), *n.* a grand-child.
nerawkai (M), *n.* an unmarried woman.
netur-kaje (M), *n.* a son.
nia, *suffix*, with, at; midö ngalpan-nia launga senabi nongo babat are not his sisters here with us? Mark, vi. 3.
niai, *v.* to sit; niai-kazi (S), an attendant, servant; contract boy (B). niai za, *n.* chair; niai lagö, *n.* a seat; niaipa ielpanö, *v.* to marry.

niaiginga, *a.* not sitting.
niain = niai.
nianö = niai. Mark, vi. 39.
nida (?), noi kaikuöimo nida idin senabi durai kikiri, he began to lay his hands upon a few sick folk. Mark, vi. 5.
nidai, (?) root of nidaipa.
nidaiginga, *v.* not to do.
nidaipa (s), *v.* to do.
nidaizinga, *n.* things done.
nidapa, *v.* to touch.
nide,
nidemin, *v.* to touch.
nidiz, **nidizi**, **nidizö** (s), *v.* to do, to make, act; done; *n.* mode (Macfarlane).
nidö,
nigita = ngita.
niki, *n.* a fern.
niki (?); köi tamö lakö niki adan, shoots out great branches. Mark, iv. 32.
nīkīagul (MB), *n.* a marine insect (*Halobates*).
ningaibia (? = ngibia), ningaibia gnulai ga (B), *v.* to translate.
nipa (M), *suffix*, for.
nisalnga, *a.* having leaves.
nis, **nīsö** (B, M), *n.* *a.* leaf.
nis-thung (M), *a.* leaf like, green.
nitamau (?), noi iautumiz mura mabaegal apa nitamau, he commanded the people to sit down on the ground. Mark, viii. 6.
nitun, **nitunö**, *v.* to put out, push out; kaba nitunö *v.* to row. Cf. getö-nitun.
nizö (?), a misprint for nidizö. Mark, v. 38.
nö, *suffix* to nouns.
nöbaba (s), *n.* skin.
nögaipa, *v.* to look. Cf. nagiz. [nögain.]
noi, *n.* a light framework erected over the fire on which to dry and smoke fish (311).
nöi, *pron.* he.
nöi, **nöia**, (s), *n.* tongue.
noidail, **nöidail**, *a.* beloved.

noidal = noidail.
noidizö, *v.* to honour. Mark, vii. 10.
nöidö, *pron.* he.
noidöka (?), noidö, ka.
nöino, noinö, *pron.* him.
noitai, (s), *n.* tongue.
none (s), *pron.* his.
nongo (s), *pron.* his.
nongongo (?). Mark, viii. 30.
nonobo,
noriza (B) (?); urö noriza (B), *n.* ebb tide.
nu, *suffix* denoting the locative case, in, at, on.
nu (s), *pron.* he, him, it.
nu' abepa (M), *pron.* for himself, = nubepa.
nubepa, *pron.* to or for him.
nubepe = nubepa.
nubia (s), *pron.* him.
nudan, *v.* to rub.
nudi (M), *n.* tears.
nudu (M), *pron.* he.
nuö (M), *pron.* he.
nukangaba guba (B), *n.* the north-west wind.
nukenmepa (?) = mokenmepa.
nuk' ĕnei (M), *a.* thirsty.
nuki (M), *n.* fresh water; dana nuki (M), a well (lit. water eye). Cf. Polynesian mata-vai, which also = water eye.
nukĭneipa (M), *v.* to thirst.
nukunoko,
nukunukö (?), nukunukö iamulizö, to reason, to think about. Mark, ii. 6, 8; mipa ngita nukunukö pöibiz? why make ye this ado? Mark, v. 39.
numaiginga. See ngona-numaiginga.
numani. See ngona numani.
nungu, *pron.* his, = nongo (Macfarlane).
nungu (s), *prep.* from; nungu korkak, from the heart. See nu, ngu.
nungungu, *prep.* from, from it; nungungu umanga, from the dead.
nunu (M), *pron.* his.
nupadö (?), nupadö-taean, *v.* to roll.

nur, nurö, *n.* a noise, a roar, a voice.
nurage (M), *a.* quiet.
nurai, *n.* a sound, = nur.
nureipa (M), *v.* to wrap round, to coil, to twist. [nuran.]
nuremĭzingi (?), wur nuremĭzingi (M), *n.* low water.
nurezingi, wur nurĕzingi (M), *n.* ebb tide.
nurile (M), *a.* noisy.
nurinuri (MG), *n.* a sweet potato.
nuriz,
nurö, *n.* a crack, an echo = nur.
nursak, *n.* the nostrils. Cf. sakai, nurse.
nurse (M), *n.* the white of an egg; the mucus of the nose.
nutan, *v.* to try, to tempt, to taste.
Nga, *pron.* who? what? (person).
ngabadö, *n.* a room; noidö sesitaman ngipelpa wara köi ngabad gimal, he (will) show you a large upper room. Mark, xiv. 15.
ngadagidö, ngadogido, *a.* equal, lawful.
ngadal, *n.* number, size; iangu ngadal mura, all parables. Mark, iv. 13.
ngadalenga, ngadalönga, *n.* a picture, image; iangu-ngadalnga (S), *n.* a parable. [ngadalngange.]
ngadalenga, *a.* numerous.
ngadalngange. Mark, i. 44.
ngadapalepa, *v.* to be proud, to boast.
ngadazia (S), *a.* legal.
ngado,
ngadu, *pron.* who?
ngaeapa, ngaiapa, *pron.* to me, for me.
ngagalaig, *n.* a hawk. Cf. nagalug.
ngai, *pron.* I.
ngai-aikeka, *pron.* for myself.
ngaibia, *pron.* with me; me, after *v.* to follow.
ngai-kusaig, *pron.* myself.
ngaingai, *n.* a boar's tusk used for polishing a wap.
ngainge. Mark, x. 29.
ngalabe, *pron.* we two (exclusive).
ngalakai = ngölkai.
ngalapipa, *v.* to lie; *n.* falsehood.

ngalbe, *pron.* we two (exclusive).
ngalbelpa, *pron.* to us two, for us two.
ngalkan,
ngalnga (S), *a.* kind.
ngalngal, *n.* a liana or climbing plant; one of the figures in womer (361).
ngalpa, *pron.* we (*pl.*) inclusive of person addressed.
ngalpaldui,
ngalpan, *pron.* our (*pl*).
ngalpalpa, *pron.* to us.
ngana, *n.* the breath, = ngöna.
nganăkapo (M), *n.* the heart, = ngönakapö.
nganö, *pron.* who?
nganu (M), *pron.* whose?
ngapa (M), *prefix* indicating motion to speaker; to bring (S); to come from a distance (B).
ngapamani, ngapamarö (B), *v.* to bring.
ngapanagemiu, see ngapa, nagepa.
ngapanagi, *exclam.* behold! lo!
ngar, ngarö (M), *n.* the leg; foot (S); ngara-pusik, a dance (362); ngara-taiermin, *n.* a dance (362); ngaraupĭla, the fibulæ.
ngaraki, *n.* a young woman.
ngarba (B), *n.* the collar-bone (ngarba-rid (Mb.)).
ngaru (M), the monitor lizard.
ngaru (S), *ad.* ever, eternal, always, never (Macfarlane); ngaru poidaipa, *v.* to trouble, *i.e.* to always be asking. Mark, v. 35.
ngatö, ngatu (M), *pron.* I.
ngaubatö (B), *n.* a woman's brother. Cf. babatö.
ngau, *pron.* mine, my.
ngauakazi = ngawakazi.
ngaukalö = ngau, kalö, after me. Mark, i. 7.
ngaumun, *pron.* my, mine.
ngaungu, *pron.* from me, through me.
ngaunguzo,
ngauwoni,
ngawa,
ngawakazi, ngawaközi, *n.* daughter. [ngawakaziu, ngawakaziutu lag, ngawakiëe.]

ngazo (s), *pron.* I.
ngi, *pron.* thou, you (*sing.*).
ngibepa, *pron.* to thee, for thee.
ngibia, *pron.* with thee.
ngidö, *pron.* thou, you (*sing.*).
ngidu, *pron.* thou.
ngika. Mark, v. 19.
ngi-kusaig, *pron.* thyself, yourself.
ngimipamapa (b), *n.* purpose (apparently a phrase, ngi mipa meipa? you do it why ?).
nginanga (?), nginanga sike ubinemepa, if thou wilt. Mark, i. 40; a mabaeg sibuwanan a ngibia amadan apatanori keda nginanga midö, and love thy neighbour as thyself. Mark, xii. 33.
ngingalkailaiga (b), *n.* idiot (*lit.* you liar).
ngino, *pron.* thee.
nginu, *pron.* thy, thine.
nginungu, *pron.* from thee.
ngipeine (m), *pron.* of you two, yours.
ngipel, *pron.* you two.
ngipelpa, *pron.* to you two, for you two.
ngipen, *pron.* your, of you two.
ngita, *pron.* you (*pl.*).
ngitaka, ngitaka mata körawaig, perceive ye not yet. Mark, viii. 17.
ngitamulngu, *pron.* concerning you (*pl.*); among you.
ngitamulpa, *pron.* to you.
ngitamun, *pron.* your, yours (*pl.*).
ngitamunia, *pron.* with you, among you. Mark, x. 43.
ngitana (m), *pron.* you (*pl.*).
ngitanămun (m), *pron.* your (*pl.*).
ngitangita, *pron.* yourselves.
ngödalenga = ngadalenga.
ngöde, *a.* like; ngöde puinge, like trees. Mark, viii. 24.
ngödo (s), *a.* like to.
ngoi, ngöi, *pron.* we (*pl.*) exclusive of the person or persons spoken to.
ngoimulpa, *pron.* to us, for us.
ngoimun, *pron.* our (*pl.*).
ngöingöi, *pron.* ourselves.
ngölkai (s), *a.* false, *n.* falsehood; liar (b).

ngomai,

ngöna, ngona, *pron.* me.

ngöna, *n.* breath; ngona-pudiz, *v.* to rest, to stay (s); ngöna-numa, *v.* to remember; ngona-poidan, *v.* to sigh; ngona-puidan (?), *n.* palm (Macfarlane).

ngönakapö, *n.* heart, mind, lit. the seed "kapö" of the breath "ngöna." The Miriam word has a similar derivation from "ner," breath and "kep," seed.

ngonamani,

ngönanuma, *v.* to remember; ngönanumaiginga, *v.* to forget.

ngöna-pudiz, *v.* to rest.

ngönu (s), *pron.* whose?

ngorngomai, ngorongomai (?), dana ngorongomai lagö, *n.* the temple. Mark, xi. 11, 15, 27.

ngorotaran (?). Mark, x. 15.

ngou-pamani, *a.* meek.

ngözo, *pron.* I (apparently only used by a female speaking). Cf. ngazo.

ngu, *suffix* from, concerning, through.

ngudi, *n.* a tear.

ngugiai, *n.* a cup of water. Mark, ix. 41.

nguki (s), *n.* fresh water; nguki-tuidan, *v.* to urinate. [ngukingu.]

ngukiai, *n.* a cup of water.

ngukulnga,

ngul (M), ngulö (s), yesterday.

ngulai, *a.* possible; ngulai za köigörsar, many things are possible. Mark, ix. 23.

ngulaig (s), ngulaigö, *v.* to be able, can, to know how, to understand; *n.* ability. [ngulaignu.]

ngulaigasin,

ngulaigöpa, *v.* to know.

ngulaik = ngulaig.

ngulaizi, *a.* chosen.

ngulaizinga (s), *a.* and *n.* chosen.

ngulamai, *a.* obscene; ngulamai za, *n.* an abomination. Mark, xiii. 14.

ngulamoin, *v.* to hate, abhor; to be disgusted with; to sneer.

ngu-mabaeg = nga mabaeg.

ngurapai, *n.* teaching, doctrine; ngurpai-mabaeg, *n.* teacher.

ngurapipa, *v.* to teach; to learn, to know, to recognize.

ngurngomizö (?), danö ngurngomizö, *n.* religion. See ngorngomai.
ngurö (S), *n.* voice. Cf. nur, nurö.
ngurö (B), *n.* the beak of a bird.
nguro-taean, *v.* to keep out, to crowd out; *n.* a wall (S); ngurö-taeamoin, they were choked, crowded out. Mark, xiv. 7.
nguro-weidaizinga, *n.* a casting out.
ngurö-weidai, *v.* to cast out, to expel, dismiss. [nguro-weidizi.]
ngurpai = ngurapai.
ngurpan. See ngurapipa.
ngurr (M), *n.* the hook or peg of the throwing stick (kobai). Cf. naur, ngurö (334).
ngursaka (M) = nursak. Cf. nur, saka.
ngursilamiz, *v.* to wink.
nguru-oidan, *v.* to dismiss = nguro-weid.
ngurupaipa = ngurapipa. [ngurupan.]
ngurupai = ngurapai.
ngurupaizinga, *n.* things taught, doctrine.

Oëbada (M), *n.* soft turtle eggs.
oka (M), *n.* a grub found in dead wood.
okŏsa (MOA, Mb, N, T) = ukasar; okŏsa ŏrŏpun, three.
onailai (?), noi ubigösia kunia onailai, he would not reject her. Mark, vi. 26.
ooja (T), *n.* a small cowry. Cf. uza.
orapuni = urapon.
oripara (M), *n.* the rainbow.
oropun, orapuni (MOA, Mb, N, T) = urapon; okŏsa ŏrŏpun, three; okosa getal, two hands, ten.
ösilai (? from asin); noi gudöwadan tanamulpa kaimi ösilai, he allowed no man to follow him. Mark, v. 37.
oudazi (?) tanamulpa oudazi poidan, healed them. Mark, vi. 13. Cf. udas.

Pa, *prefix* to verbs indicating motion; pa-uzari, go away; pa-ieudiz, pour out; pa-lagiz (pa-ilagiz), fly up; pa-pagan, to extend round, &c.
pa, *suffix* to nouns, to, for.

pa (s, b), *n.* a fence, either for garden or as a protection in fighting. Cf. ăra.

pad (mb), *n.* the tympanum of the native drum.

pad, *n.* a bird's nest. Cf. fad.

pada, padö (m, s), *n.* a wooded hill, a mountain. [padau, padapa, padria.]

pădă-kwik, *n.* the skull or head. Cf. pada, kwik.

padamö (m), *n.* a nest.

padap (s) = pada.

pădătrong (mb), *n.* a bamboo rattle (375).

padö. See pada.

padotu. See Legends, p. 180.

padra (s) = pad, *n.* the skin used for the tympanum of the native drum.

pa-dröuradiz = pa-töridiz; ukauka tana padröuradiz, four carried. Mark, ii. 3.

paekau, *n.* a butterfly. Cf. paikau.

paga (s), *v.* to throw.

pagaean, *v.* to stretch out, to extend. [pagaear.]

pagamoin (s), *v.* to sew, to mend; api pagamoin, *v.* to mend fish traps.

pagamoin, pagömöin (?); kanguru pagamoin, *ad.* round about.

pagamoman (?), *v.* pagamoman sepal azazi san, be (ye) shod with sandals. Mark, vii. 9.

pagan (s), *v.* to throw, to descend, to sting, to pierce.

pagara, *n.* a sponge. Mark, xv. 36. Cf. pazara, diadi.

pagaru (b), *n.* coral. Cf. pagara. (In Jukes' Muralug (Pt. Lihou) Vocab. this word = seaweed.)

paget (?), paget-wanizo, *v.* to slip.

pagiz, pagizo (?), mazar pagizo. Mark, v. 15.

pai,

paibanö (b), *v.* = poibanö.

paielega, paielegamoin (s), *v.* to tear.

pa-ieudiz, *v.* to pour, to add (a liquid ?). [paieudan.]

paigamozinga (s), *n.* a split.

paikău (b), *n.* a butterfly, = paekau.

paiwanö (?), *v.* paiwanö-pagan, *v.* to display.

paka, *n.* a maiden.

pakadö, *n.* a bird's nest, a cage (B). Cf. pad, fad.
pakai (T), *n.* the name given to the tail of a mask from Nagir.
pakazal (?), köi kutal töitu pögai pakazal ngalkan, for a pretence make long prayers. Mark, xii. 40.
pakölgal (?), kedazingu kai mura kikirí laig nubepa pakölgal iman, nubepa garötaean, insomuch that they pressed upon him for to touch him as many as had plagues. Mark, iii. 10.
pakomari (N), *n.* a wig. Cf. adizela, adŭdziolai.
pala, *pron.* they two.
paladö (?), ia paladö, *n.* the lungs.
palae, *pron.* they two, both.
palagis (B), *n.* the east, *i.e.* the rising (of the sun). Cf. palagiz.
palagiz, palgizö, *v.* to rise, spring up, fly; göiga palgizo, *n.* sunrise; urui palgizö, *n.* bird; kadrö palagiz, *v.* to fly down on.
palagusö, *n.* an oven, hence a cooking pot or saucepan.
palaipa, *v.* to split, to divide, to open, to pluck (corn), Mark, x. 51; to open (the eyes or ears), danö-palaipa, kaura paleman; kerkatö-palan, *v.* to torment. Mark, v. 7. [palan, paleman, palamöin.]
palaipa (S), *a.* sick.
palăman (M, S), *pron.* of them two, theirs.
palamiz (?), guda-palamiz, *v.* to overflow.
palamulngu, *pron.* from them two.
palamulpa, *pron.* to or for them two.
palamun, *pron.* of them two, theirs.
palan (?), kukö-palan, to save. Mark, viii. 35.
pale (M), *pron.* they two.
palealnga, *a.* dry.
paleipa (M), *v.* to crush, to pound with stones.
palelapudi (S), *a.* dry.
paleman, *dual* of palaipa, to open.
palenipa (M), *pron.* for themselves (dual).
palepa (?), ngada-palepa, *v.* to boast, to be proud.
palgan (? from palagiz), iadu-palgan, *v.* to tell, relate, declare.
palgapalan (S), *v.* to smash.
palge (M), *ad.* completely, into pieces.
palgin (S), *v.* to fly, to spring up, = palagiz.
palginö (B), *v.* to flog.

palĭsa (M), *n*. the down of a bird. Cf. plis.
paliz. See palaipa; dan paliz, opened the eyes. Mark, x. 52.
palngin, palengin, *v*. to scourge, to flog.
palpăgipa (M), to finish (said of women's work).
pam (S), *v*. to mean.
paman (S), *v*. to dig.
pamizin, *n*. rape.
pamizö (?), madu-pamizö, *v*. to be affrighted. Mark, i. 27. [madu-paman, madu-pamemin.]
pananamanö (B), *v*. to kick.
pange,
panin (S), *n*. adze.
panudiz, *v*. to press.
papagan, *v*. to enclose; vineu apö söwagai a papagan, planted a garden and set a hedge about. Mark, xii. 1.
papalamizö (S), *v*. to burst, to open, to break.
papataina (?), apö papataina (B), *v*. to plant a garden.
papölamöipa, *v*. to burst, to open, to break. [papalamöin.]
papoliz (S), *v*. to bruise.
papudamiz, *v*. to cease; gubö papudamiz, the wind ceased. Mark, vi. 51. Cf. pudeipa.
paradamu (MB), *n*. a species of *Cymodocea*.
parama (T), *n*. red ochre, paint made from red ochre.
paran (?), paran matapa, parana matampa (B), *v*. to snore.
paran, (S), *v*. to cut, = palaipa.
paranudan (MB), *v*. to rub noses and embrace heads.
parapar, *n*. power; *pl*. pörapöral.
pardan, *v* to draw.
parma, *n*. red ochre (M); red (N); clay.
paromatam, *n*. a female pig. Cf. burum.
parpar, *n*. power; *pl*. pörapöral.
paru (M), *n*. the forehead, the face, the front; *prep*. by (S); parunu, *prep*. in front, before.
paru-iman, *v*. to salute. [paru imamöin.]
paruidan (S), *n*. guile, decit. Mark, vii. 22.
paruidizö, *v*. to deceive.
paruma (MB), *a*. red. Cf. parama.
pasa (S, B), *n*. a doorway, gate, the opening. Cf. tamudara. [pasanu.]

pasagud (s), *n.* a door. Cf. pasa, gud.

păsei (m), *n.* a tree, the light wood of which is used for making sarima and kăraba.

pasia, *n.* a pass, = pasa.

pasikaig (s), *n.* a post.

pasim,

pat (badu), *n.* a short spear.

pataean (? throw out). Mark, vii. 21.

pataipa (? to put or jut out), danal-pataipa, danal-pateipa (s), *v.* to watch. [danal-patamoiziu.]

patalai (? prickly, sticking out), pui-patalai, *n.* thorns.

patamoin, *v. pl.* from patan.

patan (s), *v.* to cut; kuikö patan, to behead, Mark, vi. 16; gudö patan, to gnash the teeth; butupatan, *v.* to heal. [patamoin, patamoiziu.]

patapi (s), *a.* finished.

pataraidizo (s), *v.* to dispute.

patauradisö (b), *v.* to carry on the shoulder.

pate = padö.

pateipa (m), patepa, *v.* to come here.

pati (s), *n.* a bell. A Lifu word.

patidan (s), *v.* to break (perhaps to fall down, and hence break something).

patidiz, *v.* to bow; to fall down.

patiginga, from pataipa; danal-patiginga, not looking after, not watching.

patiliz (s), *a.* reverenced.

patiz, patizö (s), *v.* to sit in; gulai-patiz, *v.* to get into a ship, Mark, vi. 45, to be in a ship, Mark, i. 19.

patö, *n.* a fork.

patöridai, *v.* to question with, to dispute. [patöridizö, patöridaizinga.]

patralai = patalai.

patrauradiz, *v.* to bear, to carry. Cf. töridiz.

patrediz, *v.* to deny. Cf. gudo-tadiz.

patridiz = patidiz.

patritrizo = patridiz, patidiz.

paudö (b), peace.

paudalag, *n.* peace.

pauimizo,

pauna (s), *n.* leather.

paunap, paunapa (?), noi paunap a umizin, let him die the death. Mark, vii. 10; nginu ngarö paunapa patan, thy feet cut off.

paupa (?) paupa kutrapa, now the time is far passed; paupa kudapa, when the even was come; Lifu, heji hë, e hej, it is evening. Mark, vi. 35, 47.

paupusa (T), an ornament of the kadig (371). Cf. kadig-tang.

pautö, *n.* peace, = paudö.

pautö (B), *n.* the forehead.

pauzari, *v.* to go away; pa, uzar.

pawa, *n.* a habit, a deed, a thing done; manner; *pl.* pawal. [pawau, pawangu.]

pawadan, *v.* to rebuke.

pawaginga, *n.* nothing (done). Cf. iaginga, zaginga.

pawaliz, *v.* to land; to draw to shore. Mark, vi. 53.

pawalman (s), *v.* to arouse, to wake up.

pawizo,

paza (N), *n.* a flat fish (poisonous).

pazara (s), *n.* sponge. Cf. pagara, diadi.

pazilamiz, *v.* to attack (move against).

pearku, *n.* a kind of fish.

pĕl, *n.* the tail of a fish; the breast of a fish (M).

pĕneipa (M), *v.* to dive.

pënö, *v.* to dive (Macfarlane).

penunamez, *v.* to dive, = pënö (Macfarlane).

pĕpedu, *n.* a bamboo flick or whip, same as the Miriam "lolo."

pepe, pepenga, *a.* thin; pepe baradarangu, because it had no depth of earth. Mark, iv. 5.

perta (Mb), *n.* the wrist, the forearm; six, in counting on the body. Cf. Grammar.

pia, *n.* the bark of a tree.

pibeipa (M), *v.* to give, = poibaipa.

pichi (Mg), = piti.

pid (T), *n.* a black bee.

pideipa (M), *v.* to dig.

piepa (?) sagul piepa (M), *v.* to sing.

pigin taean, *v.* to dream.

piki (M, B), *n.* a dream; piki-lalkeipa (M), *v.* to dream.
pikuri (T), = pikuru.
pikuru, *n.* a head dress of teeth; pattern on a drum, probably derived from the head dress.
pinapai, *n.* the east.
piner (T), *n.* the name of a tree, *Erythrina* (409). (Legends, 12).
pingapa (B), *prep.* at.
pingi (B), *n.* a fishing net (? basket).
pingulpa (?) pingulpa iabugudia, in the way. Mark, x. 52.
pinin (S), *v.* to anoint.
pinlteipa (M), *v.* to shave.
piöbizi (?), noi piösial piöbizi, he marvelled. Mark, vi. 6.
pipai (S), *n.* paper. Perhaps English "paper."
pipai (?). Mark, iii. 8.
pira, *a.* soft; pira kuma (B), *n.* diarrhœa.
piranga (S), *a.* soft, = pirung.
piröan (M), *n.* a black snake.
pirung (M), *a.* soft, swampy, spongy, pliable, = piranga.
pis (M), *n.* a crack, an opening.
pisalinga (B), *n.* a leak.
pisamainö (B), *n.* rheumatism.
piti (T, M, B), the nose; piti terti (M), piti sek (M), the perforation in the septum narium (406).
pitu, *n.* a ring.
piwer (M), *n.* the mullet.
piwul (Mb), *n.* a broom. Cf. kusu, kusulaig.
plagusi (B), *n.* a pot, = palagus; turik plagusi (B), *n.* an iron pot.
po,
plis (T), *n.* feathers. Cf. palisa.
pogai,
pögamiz. See pagan.
pöi (S), *n.* dust, powder.
poibaipa, *v.* to give. [poiban.]
poibaigi, *v.* not to give.
poibanai (? from poibaipa), ba poibanai senabi mabaeg aideigan, for there shall be given to the man that has not. Mark, iv. 25.
poibi (S), *v.* to croak.

pöibizi (s), *v.* to crow; mipa ngita nukunukö pöibiz, why make ye this ado? Mark, v. 39.

poidamoin (s), to spread.

poidan (?), oudazi-poidan, *v.* to heal. Mark, vi. 13; udas-poidan, to save, rescue (Macfarlane). Perhaps for udu-zi poidan, to hang from or on the arm, hence to protect, save.

poidaipa, poidan (s), to choose, to pull, to pluck; kadaipa poidan, *v.* ordained. Mark, iii. 14; nga-poidanö (B), na-poidan, *v.* to sing a song.

poidanö (B), *v.* to hang.

poidiz (?), korkak mapu poidiz, *v.* to be displeased. Mark, x. 14.

poimanak (?), poimanak-palan, *v.* to murder.

poipetegam, *n.* the east.

poipiam, *v.* to watch. Cf. danal-pataipa.

pokani (?), pokani wapi (MB), *n.* the flying fish. Cf. puwi.

pokĕrai, *n.* a girl.

pokiridŏ (B), *n.* the kidney.

pokoko (M), pökuk, *n.* the heel.

pölai (? a cutting), minarö pölai, *n.* writing, *i.e.* cutting marks.

pongeipa (M), *v.* to sail.

pönipan, *n.* lightning; *v.* to shine.

pönizinga (?), mabaeg pönizinga, *n.* a carpenter. Mark, vi. 3.

pordai-za, *n.* a hook.

potaipa, = pataipa.

pötaizimail (?), nongo buta potaizimail, he had healed many.

pŏtur (M), *n.* a digging stick.

prak, *n.* coral, *pl.* prakil.

prateipa (M), to eat.

pratralinge. See patalai, pui.

prue (M), *n.* a tree (the general term). Cf. pui.

prutika (MG, Stone), prutai (MG, D'Albertis), *n.* food.

puban (s), *n.* paddle.

pudaizinga, *n.* things that fall; börupudaizinga, crumbs. Mark, vii. 28.

pudam (s), *v.* to pull, to pluck.

pudamoin (?), za-pudamoin, *v.* to sell.

pudan, *v.* to open.

pudanö (B), *v.* to dig taro. Cf. poidanö.

pudeipa (M), *v.* to fall down; gaiga pŭdicö (B), *n.* west.

pudemin (s), *v.* to make obeisance.

pudisö. See pudeipa.

pudiz, *v.* to undress.

pudizi (s), *v.* to retain; balbai-pudiz, *v.* to peep; ngöna-pudiz, to rest.

pudö (Mb), *n.* the shaft of a javelin.

pugan (?) ipidadö pugan, *v.* to reprobate, to blaspheme; *a.* profane; rimarim pugan, *v.* to find fault. Mark, vii. 2; watri pugan, *v.* to speak evil.

pui, *n.* a tree; a log; wood; pui-patalai, pui-patralai, *n.* thorns [puinge, puia.]

puian, *v.* to blow.

puidan, *v.* to hang; ngöna puidan, *n.* a palm (Macfarlane).

puidiz, *v.* (to hang?), paru mapu puidíz, to hang a weight in front. Mark, ix. 42.

puidiz = poidiz, korkak mapu puidiz. Mark, iii. 5.

puie (M), *n.* the fore fin of the turtle.

puiman, *v.* to suck.

puinge (?) trees.

pukatö, *n.* a locust; a grasshopper (B).

puki, *n.* a hump, the side of the abdomen.

pukuk (M), *n.* the heel. Cf. pokoko.

pulman (?), ganu-pulman, *n.* smell.

pungaipa (s), giun-pungaipa, *v.* to be foolish; berai-pungaipa, *v.* to be easy. Mark, x. 25; ikane pungaipa, *v.* to be glad. Mark, xii. 38.

pupariz (s), to flee. Cf. bupariz.

pupui, *n.* a flute.

pupumiz, *v.* to heal.

pura (M), *n.* the eyelid.

pŭra (M), skin.

purăpură, *n.* the producing of disease or sickness by magic (purĭpurĭ), a Daudai word rarely used in the islands. Cf. maid.

purapar = parpar. Mark, vi. 5.

puridan (?), guda-puridan, *v.* to be insolent.

puridöralenga (?), gamu puradöralenga, whole, well in body. Mark, ii. 17.

purka, *n.* the eyeball, the eye; purka kekermisina (B), *n.* ophthalmia.
purkăpa,
purke (M), *ad.* well, many.
purpi (M), *n.* the bee-eater. (*Merops ornata.*)
purtan = purutan.
purteipa (M), *v.* to eat.
puru (S), *v.* to steal, rob; *n.* theft.
puruka = purka; puruka parö madö gamuasin, an evil eye. Mark, vii. 22. [purukana.]
purur (M, *n.* the bark of a tree.
purutaiginga, *v.* not to eat.
purutan, *v.* to eat, ate; *pl.* purutamoin.
pusarisö (B), *v.* to pull a rope. Cf. puzarizö.
putage (M), *a.* many.
putiz, putizi, putizö (S), *v.* to fall; görga putizö, the sun goes down.
putra, putran (? = pudan), tana arakato putran lagou kalangu, they made a hole from the back of the house. Mark, ii. 4.
puwi, *n.* the flying-fish. Cf. pokani-wapi.
puzarizo (S), to compel, to haul, to constrain.
puzida, *v.* to imitate.
puzik (?), ngara-puzik, *n.* a dance (362).
puzipa, *v.* to follow.
puzo (putso) (B), *n.* a white pigeon.

Rabö (M), *n.* a mast; rab' waku, *n.* a mat used as a sail.
rada (M), *n.* a sharpened stick used for for spearing fish (333), a simple javelin.
raji (M), *a.* withered.
ramoginga, *a.* unshaded, without shade. Cf. rimö.
ranai (MG), *n.* a girl (D'Albertis).
rangadö (B), *n.* a mast.
rapepa, *a.* lame.
rapö, *n.* a claw.
ras (M), *n.* a driving cloud, scud.
ras, *n.* a lot.
rebata (M), *n.* aunt, father's sister. Cf. ama, apu.
rid, ridö, *n.* bone, skeleton; hence horn.

rid (MG), *n.* the tongue (D'Albertis).
ridanga (S), *a.* hard, bony.
ridau, *n.* enemy; *v.* to oppose.
ridu (B) = ridau.
rimarim (S), *v.* to err, to mistake; *a.* mad, mistaken; *n.* a fool; pl. rimarimal.
rimö, *n.* a shadow. Cf. ramoginga.
rogaig (T), *n.* name given by a lad to his sweetheart. Cf. azugerka, rugeiga.
ruamon (S), *v.* to understand.
rud (M) = rada.
rugăbu (M), *n.* the sweet potato.
rugalö (B), *n.* baggage; gulngu rugal, *n.* cargo, baggage from a canoe.
rugeiga (M), *n.* a sweetheart.
rugu (?) kudru rugu, a small kind of dove.
rumbadi (M), *n.* a species of water lily.

Sabi (MB), *n.* tabu, prohibition; law (S); hence, sacred; *pl.* sabil; sabi lagö, *n.* a church.
sabukemus, *n.* a needle.
sabukiri (S), *v.* to reproach.
sădeo (M), *n.* a cicatrix on the breast (sadawa, sadau).
sag, saga (S), **sagö** (B), *n.* a centipede.
sagad, *n.* a worm. Cf. kupar.
sagai (M), *n.* the horizontal fire stick (385). Cf. ini, guigui, salgai.
sagu (M), *n.* a kind of purple yam.
sagul, sagulö (M, B), *n.* a joke, play; sagul piepa, *v.* to sing.
sagul (S), *v.* to examine. (Perhaps introduced English "school").
sai, *n.* a bog; mud; shallow water on sea shore. Mark, iv. 1. [sainu.]
saima (B), *n.* the float of the outrigger of a canoe. Cf. sarima.
saka (M), *n.* a bone needle; a splinter (S).
saka (M), *n.* the lungs. See paladö.
sakai (M, B), *n.* a hole in a rock, a cave; sakai puru mabaegou lagonge, a den of thieves. Mark, xi. 17.
sakangu, see sakö.
sakö (S), *n.* cloth. [sakangu.]
sakarö (B), *n.* a web.

sakar-taean, *v.* to surname; noi palamulpa sakariā-taean Boanerege, he surnamed them Boanerges. Mark, iii. 17.

sakar-töeam (?), amadan pasanu siëi sakar-töeam, near a door where two ways met. Mark, xi. 4.

saladunga (B), *n.* a foreigner, a white man. Cf. saradönga.

salgai (M), *n.* sticks used for producing fire (collectively) (385). Cf. ini, sagai, guigui.

sali (M), *a.* sick.

salö, *v.* to bale out

salop, *n.* the melon or bailer shell. Cf. alopa, alup.

salpaman, *v.* to lave. Cf. salö, paman.

salpumeipa (M), *v.* to bale.

sam = samu.

sam (M), *a.* cylindrical.

samera (M, T), *n.* a head dress made of cassowary feathers; *pl.* sameral. Cf. dagoi.

samidö (S), *ad.* yes; really. Mark, xii. 26.

samu, *n.* the cassowary of New Guinea; samu widizi (S), *n.* crest or head dress made of cassowary feathers.

samuda, *n.* the eyebrows.

samudana (M), *n.* the eye lashes.

samudung (M), *n.* the eye lashes.

san (M), sana, the sole of the foot; the foot; sana-lumadö (B), *n.* the instep; azazi san, a sandal, shoe; nginu sananu worögi wazin, thy footstool. Mark, xii. 36 [sanangu, sananu.]

sana (MG), *n.* the cuscus.

sangopa, *exclam.* a greeting; good morning!

sapăra (MG), *n.* hatchet (Jukes). Perhaps derived from Eng. chopper.

sapi (?), Mark, xii. 42.

sapor, sapur (M), sapura, *n.* a large fruit-eating bat or flying fox, *Pteropus*.

sapurökimus, *n.* a needle (lit. a hair from sapur), sapurokimuseu goag, a needle's eye. Mark, x. 25.

sara, *n.* a white gull.

sara, *n.* posts on which the platform for corpses were supported (402). Cf. kak.

saradönga, *a.* white. Cf. sara.

saragi (M), *n.* a small stick.

sari (M), *n.* the netting of a canoe.

sarima (M), *n.* the float of an outrigger; sarim' pati (M), *n.* the pegs of the sarima. Cf. saima.

saröka (?), noi wara saröka iöbuia uzar, as he passed by. Mark, ii. 14.

sarupa (M), *a.* drowned.

sasanmepa, *v.* to decorate.

sasiman (S), *v.* to rinse, to squeeze.

sau, *n.* a rafter, a house post (B).

sazi (B), *n.* a creeper used to poison fish.

saziwaur, *n.* a year.

seadadaget (MOA), *n.* the ring finger (probably siau-dada-get, outside the middle finger).

seautari, *v.* to stop.

sebalbi, *pron.* these two.

sei, *ad.* there = siei.

seiwadadaig (B), next.

sek (M), *n.* a hole (Jukes).

sena, *a.* and *pron.* that; *ad.* there.

senabi, *a.* and *pron.* that; senabi durai, *pl.* those; senabi is often used as equivalent to the Lifu ngöne, in the.

senao, *pron.* that = sena.

senaoki, *conj.* therefore.

senau, *demons. a.* the, the same.

senebi, senobi, = senabi. Mark, iii. 8.

sepal, *pron.* both, they two. Cf. palae.

sepalbi, *pron.* those two.

sĕrăsĕră (S), *a.* a white sea or shore bird; sĕrăsĕră birgesera (415).

sĕsĕrĕ (MB), *n.* the name of a legendary hero who was changed into a bird (L. 23), probably same as serasera.

sesitaman, sestaman (S), *v.* to show, guide. [sesitomaelai.]

seta, *pron.* those.

setaura (S), *n.* cross. From Greek σταυρος.

setabi, *pron.* those.

shi (M), *n.* a strip of the yellow epidermis of an orchid.

si (M), *n.* the forehead. Cf. paru.

sia (M), *n.* the toes, ; kaba-sia, the great toe.

siaizi, *conj.* because.

siau (? = siei, sena), siau adal (s), *n.* outside.

siauki, *ad.* thither.

sib (B), sibŭ (M), *n.* the liver.

sibö-papalamiz, sibu papalamiz, *v.* to doubt.

sibu wanan (s), *v.* to have sympathy, to love, to pity.

siëe = siëi.

siëi, *pron.* that, *ad.* there; sienu, thereon; siëizi, siezi, therefrom, thence; durai siëi, those; siëiki, thither.

sier (M), *n.* the toes. Cf. sia.

sieri (?). Mark, iii. 8.

siga, sigal (s), *n.* a distance; köi sigal (s), *a.* far.

sigaman (?). Mark, v. 15, xii. 36. See wakai, mumugu.

sigataean (s), *v.* to convulse; gamu sigataean, to tear the body.

sigazi (s), *ad.* distance; koi sigazi, *a.* far.

sigo (? = sigal), ngi sigo gudalnga a launga senabi Augadan baselaia, thou art not far from God's Kingdom. Mark, xii. 34.

sik, sike, *conj.* if.

sikekai (? if will), midö midö sike kai nubepa karengemin inabi gubö a ina malu? What sort (of man) if will hear him, the wind and the sea. Mark, iv. 41.

sikiru (s), *n.* an arrow for shooting pigs. Cf. skŭri, sŭkori.

sikö (B), *n.* foam.

silamai, *v.* to fight, to scold.

silamiz (?), ngur silamiz, *v.* to wink.

silimailai (s), *n.* an uproar, a tumult.

sinapi, *n.* mustard. The Greek σιναπι.

sinupa (s), *n.* illustration.

sinupasinupa (?), tana tuelv gorsar a iapopoizö nubepa keda, midö paru sinupasinupa inö, the twelve asked of him the parable. Mark, iv. 10.

sinusëikai, *ad.* while (?), noi sinusëikai mulizö, while he yet spake. Mark, v. 35.

sipalsei, *pron.* you two there.

sipoibi, *v.* to hiss.

sĭrasĭra (M), *n.* name of a tree, the bark of which is made into fishing lines.

sirisiri, *v.* to grow up (?). Mark, iv. 8.

sirisor, *v.* to grow, = sirisiri.

sirsirnö (?). Mark, iv. 19.
siwagöi = söwagai. [siwagöiu.]
sizi = siezi, from there.
skŭri = sŭkori.
sobaginga, *a.* smart.
sobaidiz, *v.* to be slow.
sobara, *n.* a dish, charger, Mark, vi. 25, perhaps an introduced meaning for sobera.
sobera (T, N), a mat made of pandanus leaves used in the initiation ceremonies (410). (Cf. tiro of Daudai vocabulary.)
söbi = sabi. [söb'a.]
soger (T, MB), *n.* a mourning dress; (368) *pl.* sogerl.
soka (M), *a.* sick.
soki, *n.* a spike made of cassowary bone, a dagger.
sölsimizi (M, S), *v.* to wallow.
soroi (N), *n.* entrails, "guts."
sorsimiz, *v.* to move (perhaps move about). Cf. solsimizi.
söwagai, *v.* to plant.
söwakai, = söwagai. [söwakaiu.]
sowaka,
sowaki = söwagai.
sowar (M), *n.* a species of yam. Cf. ketai.
sringi (M), *n.* a cane loop or sling for carrying heads.
suagai (B), *n.* witchcraft.
sŭgu (M), *n.* the cuttle fish; the octopus (BADU). Cf. ati.
suguba, sugubö (M), *n.* tobacco; sugubö wanipa (M, B), *v.* to smoke in Papuan fashion, *i.e.* drink tobacco; sugubö marapi (M), *n.* a tobacco pipe (of bamboo). Cf. sukub.
suidaninipa (B), *v.* to crouch.
sŭkori (*n.*), an arrow with head made of a narrow, split bamboo, used for shooting pigs.
suka (M), *n.* tobacco (Jukes).
sukub, (N), sukubu (T), sukuba (B), *n.* tobacco; sukuba-marap (S), *n.* tobacco pipe; sukuba supö (B), *n.* a cigarette.
sulan (S), *v.* to pour.
sulan (?), tana akan sulan mabaegöngu, they feared the people. Mark, xi. 32.
sulangi (M), = surlangi; *n.* the turtling season (M).

suliz, sulizö, *n.* a drop; juice.

sulupan (?), kuikaiman noino mosan sulupan, began to spit on him. Mark, xiv. 65.

sulur (M), *n.* the green turtle.

sumai (M, B), *n.* cold; sumainuwedan (B), *v.* to tremble (to be out in the cold).

sumein (M), *a.* cold.

suna-suro (M), *n.* the hind fins of the turtle.

sungi, *n.* a sling for carrying heads. Cf. zinge, sringi.

sŭnö (M), *n.* the tail of the dugong.

supa (B), *n.* a white louse.

supamipa, *v.* to bear false witness. Mark, x. 19. Cf. ia supaman.

supnuran (S), *v.* to cover; *a.* wrapped, covered.

supö (B), *n.* a cover; a bale; sukuba supö (B), *n.* a cigarette.

surka, *n.* the scrub turkey (*Megapodius*) (wild fowl); surka pada, the mound of the megapod.

surlăl, *n.* the pairing of the turtle.

surlăngi, *n.* the turtle season, or the season when turtle pair (350).

surö (B), *n.* a pole for poling a canoe.

suru (M), poles or yards of sails.

surum, *n.* sand.

susu (M), *n.* the breast; gum, milk; nine, in counting on the body; wadegam susu, eleven, in counting on the body; susu gud (M), *n.* the nipple; susu nur (Macgillvray), *n.* the nipple; susu madu (Mb), the nipple; susu mina (Mb), a scarified mark on the breast.

suzu (S), *v.* to suck, = susu.

Ta (S, B), *n.* a feast.

tabai, *n.* the shoulder, *pl.* tabal.

tabal-uradiz (S), *v.* to carry on the shoulder.

tabai, *demons.* those.

tăbom (M), *n.* a long petticoat.

tabu, *n.* a snake; *pl.* tabul; umal tabu, a poisonous snake; kasa tabu, a harmless snake.

tabu, *n.* pith, perhaps also the spinal cord.

tabukiri, *n.* hate, anger; *v.* to be offended at.

taburid (Mb) *n.* the spine. Cf. göruridö, tabu, rid.

tădar, *n.* a large fly, the blue-bottle.

tadaunaizimael, *n. pl.* fragments.

tadaunaizinga, *n.* things remaining, fragments. Mark, vi. 43. Cf. unaizö.

tadin, tadina (s, b), *v.* to covet; to shoot an arrow. Perhaps really means attain, reach something aimed at; tademin. Mark, xvi. 20, confirm.

tadin (s), *v.* to rub.

tadiz (s), *v.* to rub.

tadu, *n.* a kind of crab; tadu kap (mb), *n.* the crab dance (362).

taeak, *n.* an arrow. Cf. tarek, taiak.

taeamoin, *v.* to pick, to choose. [taiamoin.]

taean (s), *v.* to throw, to dash; to invert, shove; to roll; tubal-taean, *a.* round; kuik-taean, *v.* to nod; guda-taean, *v.* to sacrifice. [taeaman, taeamoin, töcaipa, toiaipa, toeailai.]

taga (m), *n.* the mangrove. Cf. biiu.

tagi (? language).

tagir (s), *a.* dull.

tăgur (m), the name of a plant, a species of flag (*Philydrum*).

tai (mb), *n.* a place for mourning; probably any open place where ceremonies or dances are held.

taiai (n), (Legends, 180).

taiak (b), *n.* an arrow.

taiamoin = taeamoin. See taean.

taiĕk (mb) = taiak.

taidisa (b) = toidai.

taiermin (?), ngara-taiermin, *n.* a dance with jumping (362).

taima, *n.* a partition, a boundary. Cf. töimia [taimanu.]

taimi (s), *n.* boundary.

taiokwŏd (t), *n.* the sacred meeting place of men for the initiation ceremony (409). Cf. tai, kwod.

taiwa (b), *n.* the coast. Cf. tawala.

taiz, taizö (s), *n.* position; wakai-taiz, *v.* to recollect; kulai taiz, *v.* to be first; wagel taizö, to be last. Mark, ix. 35.

takam (n), *n.* the name of a fish.

taku (m), *n.* a three- or four-headed fishing-spear (333).

tal, *n.* a finger-nail, or toe-nail; the oval piece of melon-shell cemented on to the handle of the kobai, or throwing-stick (333).

taldan (s), *v.* to cross; *ad.* across. Cf. tardan.
talpura (M), *n.* glass, a bottle. Cf. Mir. tarpor.
tam, tamö (s, B), *n.* a branch, a bough; *pl.* tamal.
tamaiginga, *a.* without branches.
tamain,
taman, *v.* to witness, bear testimony. Mark, xv. 4.
tamiz, *v.* to leave.
tamamoiginga, see wakaintamamoiginga.
taman (s), *n.* the shore. Cf. taiwa, taima.
tamananga (s) = tamö.
tamoi (B), *n.* the "iguana."
tamu (M), *n.* the platform of a canoe (Macgillivray). Cf. the Mir. tum, top. The correct word is, no doubt, natara.
tamudan (s), *v.* to shut, to close.
tamudara (B), *n.* a door, that which closes the opening. Cf. pasa.
tana, *pron.* they.
tanabadö, *a.* blue.
tanaman (M, s) *pron.* their.
tanamul (s), *pron.* them.
tanamulngu, *pron.* from them.
tanamun, *pron.* their, theirs.
tanamunia, *pron.* with them.
tanatana (s), *pron.* themselves. [tanatanamulpa.]
tanenipa (M), *pron.* for themselves.
tang. Cf. tam (371).
tangu (s), *n.* a feast. Cf. ta; tangu tonar, feast time. Mark, xii. 39.
tañgi (M), *n.* name of a fish, *Diacope octolineata.*
tanoriz, *v.* to sit; kadai-tanoriz, *v.* to arise.
tanu, *v.* to sit (?) tana nubepa getö asin tanu, them that sat with him. Mark, vi. 22.
tanure, kadi tanure (M), to stand up.
tanureipa (M), *v.* to sit down.
tanuriz = tanoriz; kadai tanuriz, *v.* to arise.
tapamoin. See guda-tapaman.
tapan (M), *n.* a species of yam, *Convolvulus.* Cf. ketai, sowar.
tapeipa (M), *v.* to swim.
tapi, *n.* the sting ray. Cf. waki.
tapi (s), *n.* position; *v.* to spread, to swim.

tapi (M), *n.* a part of anything; a half. Cf. mugu.

tapimula (Mb) = tapi, sting ray.

tara, *n.* the shin.

tarai, *a.* quick, suddenly = tari.

taraitarai (B), *n.* haste.

taran (? to cut), Mark, xiii. 20, noidö taupain kai taran, he will cut short.

taratar (S), **tartar** (B), *v.* to boil.

tarbar narberit (M), *n.* the shoulder. Cf. tabai.

tardan (S), **tarödan**, *v.* to cross; *ad.* across. Cf. taldan.

taregi (M), *a.* slow.

tareipa (M), *v.* to touch.

tarek (M), *n.* an arrow. Cf. taiak, terig.

tari (M), *ad.* quickly, = tarai.

tarika (M), *n.* a gun.

tariza (S), *v.* to arise; the word seems really to refer simply to a movement of the body; kadai-tariz, to arise; kulun-tariz, to kneel

tarizelam, **tarizilamiz**. *v.* to run.

tarö (M), *n.* the nails of finger or toe; the claws of a bird. Cf. tal.

tarödan = tardan.

taröiginga (?), mabaeg wörögi taröiginga, whereon never man sat. Mark, xl. 2.

tarötaiz, *v.* to take in, to go in (of plants and seed) (?). Mark, iv. 8.

tarötöiaiginga, *v.* not to take in, not to understand (?); tanamun korkak tarötöiaiginga senabi ia, they understood not that saying. Mark, ix. 32.

tarpeipa (M), *v.* to sew.

tartaean, *v.* to delve. Cf. tarotaiz, tarte, taean.

tarte (M), *n.* a hole; tarte paleipa (M), *v.* to bore a hole. Cf. terti.

tarteipa (M), *v.* to turn over.

tatagamulinga (B), *a.* brown.

tata, **tataia**, *v.* to stammer. Cf. tratra.

tati (M), *n.* father; the general term, not vocative; keuba-tatí, *n.* uncle. [tatipa.]

tatureipa (M), *v.* to make (said of men's work).

tauanga, *a.* light, easy. Mir. pereper

taumi (B), *n.* an ant.

taupainanga (S), *a.* short.

taupain, taupainga, *a.* short; taupain töraiginga, not to shorten. Mark, xiii. 20.

tauradiz = töridiz, kama-tauradiz, *v.* to nurse in the arms.

tawala (S), *n.* the shore. Cf. taiwa, taima.

tawpei (M), *a.* short, low. Cf. taupainga. Mir. teupai.

tazo,

teio, teipa (M), *v.* to throw into.

ter, tera (M), *n.* bitterness; savour (in Gospel), *v.* to flavour; alasiu ter, the saltness, Mark, ix. 50; ter unaipa, to leave a taste, to savour.

teralnga, *a.* sour.

terari (M), *a.* sour.

terig (M), *n.* an arrow.

terku (T) = turku.

terti (Mb), a hole; piti terte, *n.* a hole in the septum narium (406). Cf. tarte.

tete (B), *n.* the leg.

thi (M), *n.* a cliff.

thölpën (?), sepal magina mani keda wadögam sapi thölpën, two mites which make a farthing. Mark, xii. 42.

thung (M), *suffix*, like, same as.

ti (B), *n.* bread fruit.

tiap (Mb), tiapi (M), the wrist.

tiati (B), *n.* a traitor.

tiapururu (Mb), *n.* a string armlet (394).

tidaimipa (B), *n.* joint.

tidan (? to make or put out); balbai tidan (S), *v.* to rectify, make straight; tonar tidan, tonar tidanö, *v.* to testify, to mark, to prove.

tideipa (M), *v.* to break, as a stick.

tidiz, *v.* to retreat; kunia tidiz (S), *v.* to return.

tigi (S, B), *n.* the brain.

tĭgu, *n.* headache.

tikat, *n.* a flea.

tiki (M), *n.* the name of a shell (*Sanguinolaria*).

timĭ, *n.* the name of a plant, *Abries precatorius*; timĭ-kapu, *n.* small red and black timi seeds (crabs' eyes) *pl.* timi-kapul.

tiom (?), magi tiom (S), *n.* boy.

tira (MB), *n.* the holes bored in a canoe and its gunwale.
tĭra (M), *n.* the leg; the ancle.
tiriap (MG), *v.* to sneeze.
tiridisa (B), *v.* to lift, = töridiz.
titan,
titoi (B), *n.* a star, = titui.
titu, *n.* a star, *pl.* titul.
titui (S), *n.* a star.
titui (?), kutam-titui, *n.* a species of hawk.
titure (M) = titui; gariga titure (M), *n.* the morning star; titure uzarizi (M), a falling star.
töad (S), *n.* the roof of a house.
töaizinga, *n.* things that are thrown; ngitamun kakurupa töaizinga, things thrown to your feet, your stumbling blocks or trespasses. Mark, xi. 25.
tobai (T), *n.* a mat.
töbud (?), senabi töbud buruman ulak, a great herd of swine feeding. Mark, v. 11.
töda, *n.* a bee.
todi (M), *n.* tortoise-shell.
todi (M), a fish hook (? made of tortoise or turtle shell). Cf. tudi.
tödipa (?), apia tödipa, to pass by (apia, from apö).
töeaipa. See taean.
togui, *n.* fin (?); baidama togui (N), *n.* shark's fin; baidama sai togui (N), *n.* a shark's tail.
toiai. See taean.
toiaipa. See taean.
toidai (S), *v.* to bite. [toidiz.]
töidail, *a.* wild, *i.e.* biting; toidail urui, *n.* wild beasts. Mark, i. 13.
toidal (S), *n.* animals. See töidail.
töidan, *v.* to dip; kuli toidiz, *v.* to steer.
toidi (S), toidiz, *v.* to bite.
töimia (S), *n.* boundary, = taima.
toitupagailai, *n.* prayer.
toitupägaipa, töitupägaipa, *v.* to pray; *n.* worship. [töitupagiz.]
tŏkiŭp, *n.* a man's brother, or woman's sister. Cf. babŭd, tukĕap.
tŏkoiap = tukĕap.

tökuiapö (B) = tökoiap.

toma (?) = tuma; senabi nubepa toma ngönanumani senabi korkak badaginga, to love him with all the heart. Mark, xii. 33; lest. Mark, iii. 9.

tomaka (s), *ad.* perhaps.

tömamiz. See ukain.

tomamoiginga,

tomar,

tonar (s), *n.* a sign, time; a mark or cicatrice; an exhibit (s); aingu tonar, food time. Mark, xii. 2. The equivalent of the Mir. mek. tonar tidanö, tonar tridan, *v.* to testify, to mark, to prove; *pl.* tonaral.

töngawa (?). Mark, ix, 42.

topi, *n.* the name of a bird.

töra, *n.* a ridge. Cf. köru.

töraiginga (?), urapon ia ina ngibepa gamu töraiginga, one thing thou lackest. Mark, x. 21. Probably a misprint for töridaiginga.

toridaiginga, töridöiginga, v. not to receive.

toridan (s), *v.* to sail.

töridan, *n.* a neighbour.

töridiz (s), *v.* to carry, lift, raise; to accept, receive; kuibur-törödiz, *v.* to be tame.

tormai. See ia tormai.

totaku (Mb). *n.* the hull of a canoe.

töti = tati. [tötiu.]

towanga, *a.* easy, light. Cf. tauanga.

tra, *n.* the hills of the termites.

tradiz = tadiz.

tragör, *a.* hard (? = tagir, dull); tanamun tragör korkak, their heart was hardened. Mark, vi. 52.

trapot, *n.* the dorsal fin of a fish; muingu trapot, mutu trapot, *n.* the pelvic fin.

tratra, *a.* deformed; stammering, having an impediment in the speech; tratra idaig, *n.* stammerer.

tridai,

tridaiginga,

tridan = tidan.

tridiz = tidiz.

tridizö = töridiz.

tritraiginga. See getö tritraiginga.

tritraizi, *a.* withered; tritraizi gitalenga, having a withered hand. Mark, iii. 3.

tritran = tidan.

tronar = tonar.

tru (?), tru minera (T), *n.* a mark on the side of the face.

trukuiap = tukuap.

tsika (M), *n.* a foam. Cf. sikö.

tu (Mb), *n.* a petticoat made of shredded coconut leaves worn by men when dancing (365).

tu (S, B), *n.* smoke; dust (Macfarlane).

tuana,

tubal (?), tubal-taean (S), *a.* round.

tubö (?), tana ngitamulp tubö nidaiginga, whosoever shall not receive you. Mark, vi. 11.

tudan (?), döra tudan (S), *a.* weeded.

tudi (M), *n.* a fish hook. Cf. todi.

tüga (M), *n.* a mangrove swamp. Cf. taga.

tugö (Mb), *n.* pole of outrigger.

tuginga, *a.* clean.

tuidan (?), nguki-tuidan, *v.* to urinate.

tukĕap (M), *n.* a man's brother or a woman's sister (Macgillivray); a friend, a guest, a cousin (B).

tukuap (S), *n.* a companion, a mate.

tulaiginga, *a.* clean.

tulainga (S), *a.* dirty.

tuma (B), *v.* wait-a-little; *conj.* until; tuma lakö kai igililenga mabaegau kazi umangu, till shall be living again the son of man from death. Mark, ix. 9.

tumai,

tumatuma (M), *ad.* by and by, presently. Cf. tuma.

tumaiauian (S), *a.* attending.

tumawaean, *v.* to compel.

tumi (M), *n.* a small black ant.

tumit (M), *n.* dirt.

tumităle (M), *a.* dirty.

tun, tuna (M), *a.* a large barbed javelin or "spear" (333).

tunan (MG), *v.* sleep (D'Albertis).
tuo (M), *n.* smoke. Cf. tu.
tupaltaean, *v.* to fold (= tu, Eng. two, pal = pala, taean).
turam (?), iadu turam, *v.* to inform.
tureipa (M), *v.* to call for; turan (S), *v.* to call, to bid (B).
turik, turika, *n.* iron, a blade; aga turik, *n.* an axe; gi turik, *n.* a knife; elap turik, *n.* hoop iron; turik plagusi (B), *n.* an iron pot.
turk, turkö (N), *n.* the bowl of a bamboo tobacco pipe.
turkĕkai (M), *n.* a man.
turkiam (N), (?) turkiam merkai.
turkikai, *n.* a cock-fowl.
turkŭ (S) = turk.
turong (M), *a.* light. Cf. towanga.
tusi, *n.* a letter, a book. A Samoan word introduced *viâ* Lifu; hence, tusi mina, Bible, *i.e.* precious or true book.
tutio,
tutu, *n.* a rod.
tuwa (377).

U, *suffix* denoting the possessive case, of.
ua (M), *ad.* yes.
uari (T), *n.* lime.
ubalö, *n.* bladder; ubal-madu (B), *n.* the calf of the leg.
ubi (M), *n.* greediness; *v.* to want (S).
ubigasin, *v.* to dislike (Macfarlane).
ubigiasin (S), *v.* to ignore, to be without a wish for.
ubigösia (?), noi ubigösia kunia onailai, he would not reject her. Mark, vi. 26.
ubile (M), *a.* greedy.
ubilnga, *n.* will, wish; ngau ubilnga lakö maigi, kapuza nginu ubilnga, not my will but thy will. Mark, xiv. 36.
ubimepa = ubinmepa.
ubin, *n.* a wish.
ubinmepa (S), ubinemepa, *v.* to wish, to desire, to like. [ubin-meamaipa.]
ubinmizi (S), *v.* to love.

ubu (M), *n.* the name of a plant (*Melaleuca* (?)). See wobu.
ubur (M), *n.* the name of a plant (*Mimusops kaukii.*)
udar (MG), *n.* an oar. Cf. Mir. uzer.
udas-poidan, *v.* to rescue, to save. See oudazi.
udu, (M), *n.* the arm, the upper arm.
udumă (B), *n.* dirt.
udup, *n.* hiccough.
ugan, uganö (S), *v.* to wait.
ugauganpagaip, *n.* noise.
uiai,
uialai. See gudauiailai.
uiamai, uiaman, uiamoin, uiamon. See wakaea-uiaman.
uiu, *n.* side.
uka, (S), *a.* two.
ukailenga (?), Iesu muasin walmizin senabi koiaböu ukailenga, after Jesus cried with a loud voice. Mark, xv. 37.
ukain (?), senabi warwar ukain tömamiz, the cares of this world. Mark, iv. 19.
ukamenamö (B), *a.* double.
ukamodobigal, *a.* three, thrice (Macfarlane).
ukamodobilgal, *a.* third.
ukamoin (? double), tana lakö worgi ukamoin umanga, these shall receive greater punishment. Mark, xii. 40.
ukasar, *a.* two; ukasar-ukasar, four.
ukasukusukö (?), mata ngadagido ngi muia utizö nabi igilelenga a nginu getö paunapa patan a ukasukusukö kalmel genapa taean, it is better thou enter into life maimed, than having two hands to go into hell. Mark, ix. 43.
ukasure = ukasar.
ukatam, *a.* ripe. Cf. katam.
ukauka (B), *a.* four; ukauka modobai, five.
ukesar (MG), *a.* two,= urapon; ukesar warapon, three.
uki (MG), *n.* fresh water (Jukes). Cf. nguki.
ukŏsa (M), *n.* two, = uka.
ukwăsur (uquassur, Macgillivray) (M), *a.* two. (uquassur warăpune, three; uquassur-uquassur, four.)
uladiz,
ulaig (?), tanamulpa göugu ulaig, healed them. Mark, vi. 5.

ulaipa, *v.* to follow. Mark, xiv. 54.
ulak (?), senabi töbud burumau ulak, a great herd of swine feeding. Mark, v. 11.
uleig (M), *a.* wet. Cf. urainga.
uleipa (M), *v.* to come, to approach.
um (s), = uma.
uma (M), *a.* dead; *n.* death; *v.* to kill (s); uma-matan (s), *v.* to drown, umau lagö (s), *n.* house of dead, tomb; uma kazi, *n.* abortion; uma mạtaman, *v.* to murder; umau nguki, poison. [umau; umapa, umangu.]
umagigal, *a.* not dead.
umaginga, *v.* not to die.
uma-gud (s), *a.* stale.
umai, *n.* the dog, *pl.* umail; umai-dangal (Mb), *n.* a necklace or coronet of dogs' teeth.
umal (B), *a.* venomous, deadly.
umalïza, *n.* (a deadly thing?); umalizö matumeipa (M), *v.* to wound.
umamail, *n.* the dead.
umamöipa (?), ngita ia umamöipa tana mulpa? What question ye with them? Mark, ix. 16.
uman (?), ia uman, *v.* took counsel, Mark, iii. 6; tanatana ia uman, they said to one another. Mark, iv. 41.
umanga, *a.* dead, sick; *v.* to die; *n.* death.
umangange (?), noi kedangadalnga umangange, he was as one dead. Mark, ix. 26.
umanguzö, *n.* *abl.* from the dead (?).
umapa (s), *v.* to kill. Cf. uma, umanga.
umaulai (?), tana getöwanizö senabi umaulai dögam utui, they let down the bed wherein the sick of the palsy lay. Mark, ii. 4.
umeipa (M), *v.* to make (said of women's work). Cf. tatureipa.
umem (Mg), *n.* death. Cf. uma.
umen (?), burumal köi umen nanitan, the swine ran down a steep place. Mark, v. 13.
umizin (?), noi paunap a umizin, let him die the death. Mark, vii. 10.
umkuki (humkuki) (Mg), *n.* water.
umu, probably = gamu.
umuwalepa (s), *n.* palsy; *a.* faint, trembling.

una,

unab (S), *a.* safe.

unabo (S), *v.* to bless.

unaigi (?), getö mina unaigi, hath never forgiveness. Mark, iii. 29.

unaipa (?), ter unaipa, to savour (taste remains). Cf. unaizi.

unizimaen, *n.* fragments, remain

unaizi, unaizö (S), *v.* to remain behind, to be left; senabi kalapa unaizö ipokazi, the woman that remained behind. Mark, xii. 19.

nuao (M), *n.* the hawk's-bill turtle.

unawa, *n.* turtle-shell. Cf. wanawa.

ungwakazi (B), *n.* woman. Cf. ngawa kazi.

uotiz, *v.* to disappear.

upi, *n.* a large bamboo knife.

upiri (B), *n.* poison.

upiuz (S), *v.* to whistle.

upu (M), *n.* a chain of ponds; a blister.

ur, urö, *n.* water, brackish water (B); ur budaman (B), *n.* raft; urö waisa (B), *n.* flood tide; urö noriza (B), *n.* ebb tide. Cf. wĕr.

ur (MG), *n.* fire. Cf. miriam ur.

urab, urabö, urap, *n.* the coco-nut, the drinking nut; urab a bura (M), *n.* coco-nut leaf. Cf. mutale, gi, baribara.

urai. See ur, urö; urai dudupisa (B), *v.* to drown.

urainga, *a.* wet, moist.

urapa (S), *a.* the same.

urapon (S, B), *a.* one.

uraponia, *v.* to agree. Cf. urapon, ia.

urapu = urapon, urapa; urapu ia, the same words. Mark, xiv. 39.

urapun, urapuni (M), *a.* one, = urapon; urapuni-getăl, five.

urazi (MB), *n.* the olive shell.

ure (M), *n.* a bird, an insect, a shell, = urui, uroi; natam-ure, *n.* a temporary name for us, quartz. (338).

urge (M), *a.* wet. Cf. urai, ur.

urge (?), urge daje (M), *n.* a long petticoat.

urilonga (M), *a.* nothing (Macgillivray).

urimanö (B), *v.* to strike.

urma (M), *n.* dew.

urmi (S), *a.* ferocious.

uro (M) = uru.

uroi (M, B), *n.* an animal, a bird, an image; uroi lagö (B), *n.* a cage; urui palgiz, *n.* bird.
urpu, *v.* to anoint.
uru (M), *a.* white.
uru (Mb), *n.* rope used for turtle fishing.
uru (Mg), *n.* the sea. Cf. ur, urö.
urudan (SV), *a.* obscured. Cf. iradu.
urugabau (S), urugabao (B), *n.* sweet potato. Cf. rugăbu.
urui (N) = uroi, a mask.
urukamö, *n.* rope, string; mapil urukam (S), *n.* chain.
uruwain (Mb), a stone used in sorcery (399.)
urupugan (S), *v.* to bathe.
urza (M), *n.* the loggerhead turtle.
us, *n.* a cut, a cicatrix.
us (M), *n.* quartz.
usa (M), *n.* the kangaroo. Cf. usaru, usur.
usabutu, *n.* salt. Cf. alas.
usal (?), mausa-usal, *n.* a scarification of the cheeks, = bagamina (367).
usar (S), *v.* to walk, go.
usaru (B), *n.* the kangaroo, wallaby. Cf. usa, usur.
usimai (S), *v.* to extinguish.
usimaipa gub, *v.* to kill the wind (427).
usimoi (S), *v.* to extinguish.
usimoiginga, *v.* not to extinguish.
usur (M), *n.* the kangaroo, = usa, usaru.
utaiginga, *v.* not to enter.
ute (M), *n.* sleep.
uteipa (M), *v.* to sleep.
uteipa (M), *v.* to enter, to go out of sight. [utem, uteman, utemin, utiz, utizi, utizo.]
utiz, utizi, utizö (S), *v.* to hide, to go into, to enter.
utoi = utui.
utointiaipa, *v.* to doze.
utömoin, *v.* to join.
utu (M), *n.* honey.
utu (M), *n.* a small palm (*Seaforthia*).
utui (S), *v.* to lie down, to sleep; *a.* asleep.
utuilö (S), *v.* to dwell.

utuipa, *v.* to lie down, to sleep.
utulag (MG), *n.* a house (Stone), lit. = sleeping-place.
utumiz, utumoin, utumoizinga. See iautumiz.
utuipa, *v.* to sow.
utuna (B), *v.* to plant.
uza (T), *n.* a small cowry. Cf. ooja.
uzai (M), *a.* putrid.
uzameipa,
uzar, *v.* to go, to walk, to depart. [uzaripa, uzariz, uzareman, uzarman, uzarmöriu.]
uzaripa (M), *v.* to go away.
uzarizi (M), *v.* to go away; titure uzarizi (M), *n.* a falling star.
uzarmöriu *v. imperat.* go; ngipel uzarmöriu, go ye two.
uzimeipa (M), *v.* to go out (as a fire). Cf. usimai, usimoi.
uzu (M), *pron.* mine (if a female).
uzur,

Wa, *ad.* yes; *v.* to acknowledge; particle of emphasis preceding verbs, wa kapuza ina ngita adataean Augadan sabi, full well ye reject God's law. Mark, xii. 9.
waba, *n.* dove.
wad (MB), *n.* a fish with blue spots.
wădai (T), *n.* a large, red, flat bean or seed.
wadan (S), *v.* to caution, to detain.
wadegam = wadögam, wadegam susu, eleven, wadegam-zugu, twelve, in counting on the body.
wadögam, *n.* the farther side, Mark, x. 1; wadökapa, to the other side.
wadokam (S), *n.* half, the other side; wadökam malu, the other side of the sea. Mark, v. 1.
wadökapa. See wadögam.
waduam, *n.* uncle. Cf. keuba-tati.
waean (S), *v.* to send. [waeaman.]
waeapa, *v.* to swim.
wagal (S), *ad.* behind. See wagel.
wagar, *exclam.* yea! yes!
wagedegam, *n.* the west.
wagedö (S), *a.* other.
wagedöka, *n.* the other side. Cf. wadögam.

wagel (M, S), *ad.* last, after, *v.* to come after. Mark, xiv. 28.
wagetăl-wagĕtal (MOA, BADU), ten (lit. one hand and one hand).
wahu, *exclam.*
waia,
waiginga (? maiginga), iabuia waiginga, nothing by the way. Mark, vi. 8.
waiitutu (M), *n.* the saw-fish; waiitutu kap, *n.* the saw-fish dance.
wainis (Mb), *n.* a small bull-roarer with a shrill sound (375).
waipa (B), *n.* a land-shell.
waipat (Mb), *n.* a head-dress consisting of a single plume.
waisa (?), urö waisa (B), *n.* flood tide.
waitud (Mb) = waiitutu.
waiwai, *n.* the testicles. Cf. waiwi, mango.
waiwi (Mb), *n.* an armlet made from the shell of the *Conus millepunctatus* (339).
waiwi, *n.* the mango.
wakabi (Mb), *n.* an instrument used in mat making.
wakadar, *n.* a dale, valley.
wakaea,
wakaean, *v.* to chase, to pursue.
wakaeangan, *v.* to be patient.
wakaea-uiamoin (?), *v.*; köi görköziu wakaea uiamoin, *n.* chief priests. Mk., xiv. 1. [wakaea-uiamoin, wakaea uiamon, wakaia-uiamai.]
wakai, *a.* ecclesiastical (Sharon); wakai mumugu sigaman (?) Mark, v. 15, xii. 36.
wakai (?), kapu wakai böie daparngu adapadan, a voice came from heaven. Mark, i. 11.
wakaia-uiamai. See wakaea-uiamoin.
wakaiasin, *v.* to pity, to regret; to have sympathy, to mourn; *n.* grief. [wakaiasimoin.]
wakaimizin, *v.* (?); ada wakaimizin, *n.* spite.
wakaintamamiz (S), wakaintömamisö (B), *v.* to think, to consider.
wakaintamamoiginga, wakaintömamoiginga, *v.* not to consider, not to think.
wakaisin = wakaiasin.
wakaisupaman, *v.* to lead astray.
wakaitaiz, *v.* to recollect, to understand. [wakaitamain.]
wakaitamamai, *n.* thought.

wakaiuiaipa (?), ngai ngitamunia wakaiuiaipa puzipu, I was daily with you teaching. Mark, xiv. 49.
wakasin (?), dönga wakasin, *a.* savage.
wakasin = wakaiasin.
wakasu, *n.* oil; kaigörsar kikirilaig wakasunu pinin, anointed with oil many sick persons. Mark, vi. 13. [wakasunu.]
wakau (S, M, B), *n.* a belt, the band of a petticoat; *pl.* wakawal.
wake (B), *n.* the hornbill. Cf. worke.
waki (M), *n.* a sting ray; a spear armed with spines from the sting ray.
wakiantämizö = wakaintamamizö.
waku (M, S), *n.* a mat; gul waku, *n.* a sail; duma waku, *n.* clothing.
waku (B), *v.* to sell. (Perhaps a misprint for sail).
walaika (Mg), *v.* to walk.
walap, *n.* a hat; pätralae pui patan walap, plaited thorns (for) a hat. Mark, xv. 17.
walchi (M), *n.* the name of a plant, *Xerotes Banksii.*
waleipa (M), *v.* to climb.
waleipa (?), gi waleipa (M), *v.* to laugh.
walepa. See umuwalepa.
walgan (B), *n.* an adze.
wali (M), *n.* name of a creeping plant, a vine used for making fishing lines, hence a fishing line; a cord, twine (B).
waliz, walizö (S), *v.* to climb, ascend.
walkadun (M), *n.* a wallaby.
walmizin, walömizin, *v.* to call, to proclaim, to cry out. Cf. walö. [walmer, walmeamain.]
walnga (Mb), *n.* "rock-fish."
walö (B), *n.* a cry; a cooey.
waltidun, *v.* to cry out (*pl.*). Mark, xv. 13.; they cried out.
walunga, *n.* the steering board, "rudder" of a canoe.
walupa (S), *v.* to plant.
wama (T), wamö, *n.* honeycomb; wamau-idi (T), honey (lit. honeycomb's oil). Cf. isau.
wamen (S), *v.* to walk quick.
wamenudiz (S), koi wamenudiz (S), *v.* to ebb, of the tide.
wamulaigö (B), *n.* a sister who has children.
wanan, *v.* to put, leave, deposit (S); durai wanan, *v.* to remain; sibu wanan, to pity. [wanemiu.]
wanawa (B), *n.* turtle shell. Cf. waru kara, unawa.

wanemiu. See getöwaniz.
wanĕs (M) = wainis.
wangai, *n.* the "wild plum."
wangepa (M), *v.* to fill (with solids), seven ianalö wangamoinö, they filled seven baskets. Mark, viii. 8.
wani (MB), *n.* the soft turtle.
wani, *n.* drink.
waniman. See wanipa.
wanin (B), *v.* to drink.
wanipa, *v.* to drink; suguba wanipa, to smoke, *i.e.* to drink tobacco. [wanin, waniu, waniman.]
wanizö (S), *v.* to drink.
wanizö (?), paget-wanizö, *v.* to slip.
wan-nur (M), *v.* don't.
wap, *n.* a dugong spear (351).
wapăda (M), *n.* the cotton tree (*Bombax.*)
wapai (M), *n.* the forearm.
wapi, *n.* a fish; pokam wapi (MB), *n.* the flying fish.
wapu (M), *n.* the shaft of a dugong spear. Cf. wap.
war = wara; war dadim, *a.* two in counting on the body.
wara (M, S), *a.* another; a, an, one (S); wara . . . wara, the one . . . the other.
warabon = urapon, one; warabon augosa, three.
waradogam (S), *n.* east.
waralaig (?); dorgai waralaig, name of a constellation. (Legends, 31).
warange (S) = wara.
warănis (M), *n.* a green pigeon.
warapon (MG) = urapon, one; ukesar-warapon, three.
warăpune (M), *a.* one, = urapon.
warawara,
waraz, *n.* the olive shell. Cf. urazi.
wardadim. See war.
wardan, *n.* an eclipse.
wargaiga (B), *n.* yesterday.
warö = wara.
waroi (MB), *n.* a common siluroid.
warögiawaliz (?) ngaukalö ngapa uzar parpar warö giawaliz, after me cometh another mightier than I. Mark, i. 7. (giawaliz perhaps = giuwaliz.)

waru, *n.* a turtle; tortoise (MG); warukaz, a young turtle; kidu waru, the end of the turtle season; waru kara, turtle shell. Cf. iniltiam.

warup, *n.* a drum.

warwar (?) senabi warwar ukain tömamiz, the care of the world. Mark, iv. 19.

wasalolnga, *a.* rough.

wasili (T), *n.* a kind of basket.

wata (S), *n.* dry wood, fuel.

watal,

watang (M), *a.* dry.

wata' pateipa (M), *v.* to dry up; wata patain (S), *n.* dry ground; watö patan nanu kulka, her blood dried up. Mark, v. 29.

watar, watarö, *n.* firewood, fuel.

watekum (M), *a.* sorry.

wati, *a.* bad, evil, abominable; wati ngarare (M), *a.* lame (bad footed); wati ganule (M), *a.* stinking (bad smelling); wate mităle (M), *a.* bad tasted; wati kaurare (M), *a.* deaf (bad eared); wati parure (M), *a.* ugly (bad faced); wati kikiri (S), *n.* sin.

watipawa (S), *n.* sin, evil deeds.

watiza, *n.* a bad thing.

watö (S, B), *n.* a year; *pl.* watal; aigi watö, famine, foodless time. Mark, xiii. 8.

watri = wati.

watripawa = watipawa. [watri-pawangu.]

watrö = wati.

watu (MG), *v.* or *n.* whistle.

watur (M), *n.* a log. See wata, watar.

wau (B), *n.* the betel nut (not eaten in Torres Straits); wau iana, *n.* a purse. Mark, vi. 8.

waura (B), *n.* the east wind; the south-east wind.

wauri,

waus (N), *n.* a funeral screen (320). Macgillivray, ii. 37.

wawpi (M) = wapi.

weăma (M) = wem.

webăsa (MG), *n.* the eyebrow. Cf. babasam, boibasamu.

weiam = woiam.

weibad, *n.* turtle eggs.

weidaman (?), mosöbauka weidaman, foaming. Mark, ix. 20.

weidan, *a.* greedy.
weidan (?), kula mura weidan, senabi mura kula weidan ina, buildings. Mark, xiii. 2. Cf. nguro-weidan.
weidizi,
welmeipa (M), to waken. Cf. wal, walmizin.
wem, *n.* the cockatoo.
wĕr (s), *n.* water.
wera (M), the stomach.
weragi (M), hungry (lit. no stomach). Cf. maita iginga, Mir. wererge.
wiamö (B) = weiam, woiam.
wibu (M), the name of a plant (*Parinarium*).
widan (s), *v.* to sew.
widizi,
wiepa (M), *v.* to give.
wier (M), *n.* the palm of the hand.
wila (M), *n.* a species of freshwater herring.
winipa (M), *v.* to get up.
witiganu, *n.* a stink. Cf. wati, ganu.
wobar, *n.* a fruit = ubur.
wobu (M) = ubu.
woiam (s), *n.* a joint.
woibadö, *n.* spawn. Cf. weibad.
wokailönga (?), Iesu walmizin senabi köi nurainga kapu wokailönga, Jesus cried with a loud voice. Mark, xv. 34.
wokau (T), *n.* a belt, = wakau.
wokowai, *n.* a belt, = wakau.
womar = wome.
wome (T), *n.* a string game "cat's cradle" (361).
womer (M) = wome.
womer (T), *n.* a sea bird, perhaps the frigate bird.
womiraukwik (T), *n.* a carved wooden bird's head for decoration of a [canoe.
wönigi = wanigi, *v.* not to drink.
wönizinga, *n.* drinking.
worgi = wörögi; maigi wara kulanu worgi wanan kalmel pudailai, there shall not be left one stone upon another, that shall not be thrown down. Mark, xiii. 2.
worke, *n.* the hornbill. Cf. wake.
wörögi (s), *ad.* upon; mabaeg wörögi taröiginga, whereon never man sat. Mark, xi. 2.

woropu-taean, to throw down, to stumble, to offend. Mark, ix. 43, 45, 47.

worpupudaiginga (?). Mark, vii. 4 (not wash ?).

wukö (B), *n.* gum.

wunu (M), *n.* a fog.

wur (M), *n.* the sea; wur pusakuradun, high water; wur nuremizingi, low water; wur kamizingi, flood tide; wur nurezingi, ebb tide.

wurup,

Za, zö, *n.* a thing; niai za, *n.* chair.

za (M), *affix*, expressing the thing spoken of.

zabai, *n.* the pectoral fin of a fish.

zabudamöin, *v.* to buy.

zadögam (S), *n.* the south.

zaget, zagetö, zagito (S), *n.* work, labour. Cf. za, getö.

zagetölaig, *a.* having work; noi zagetölaig kuikulumaingu, he has work from the Lord, the Lord needs him. Mark, xi. 3.

zagetopawa (S), *n.* a deed, a doing.

zagi (S), zagigal (S), *a.* penurious, poor (lit. without a thing).

zaginga, *a.* having nothing, empty.

zagitapa, *v.* to prepare, get ready.

zagita (S), *n.* work; *pl.* zagital. Cf. zaget.

zai (?), zai adu palganö (B), *n.* a signal.

zalaunga (?), mina zalaunga senabi göuga tanamulpa gamu puridöralenga, they that are whole have no need of the physician. Mark, ii. 17.

zamiak (?), na sulan ngau gamunu a zamiak ngaeapa maramatöiaipa, she is come aforehand to anoint my body (pour on my body) to the burying. Mark, xiv. 8.

zamozamo (S), *n.* a tail ornament made of cassowary feathers used in a dance. Cf. nadur, kabonadur.

zamu (S), *n.* the cassowary. Cf. samo.

zanga (S), *n.* a thing.

zanguzangu (?), things, *pl.* Mark, x. 27, xi. 11.

zapawaean, *v.* to send.

zapla (?), kabu zapla (T), *n.* discs held in the hand during a dance.

zapudamoin (S), *v.* to compensate, to gain, to sell.

zapul (s), *n.* riches, wealth. See za, apu. [zapuzu, zapuia.]
zapulaig (s), *a.* wealthy.
zapupamoin (?), misprint for zapudamoin.
zaputamoin = zapudamoin. [zaputamoigigal.]
zāram (m), *v.* name of a fish, *Pelates.*
zarzar (mb), *n.* leafy twigs.
zasei, = za, sei, these things.
zaungalaig (s), *n.* a shelf.
zazi (mb), *n.* a large leaf petticoat. Cf. gagi.
zazuman, *n.* firewood, fuel.
zeinga, *a.* level, smooth; *n.* a plait, a flap.
zelamiz = zilamiz.
zeza, *n.* a creek.
zi, *suffix* to pron. from.
zia (s), *n.* a cloud. [ziangu.]
zilamiz (s), *v.* to run.
zinga, *suffix.*
zinge (s), *n.* a sling for carrying heads, = sunge.
zirasan,
ziziman, *v.* to drive.
zö = za.
zogo (m) = zugu.
zorki, *n.* a spike of cassowary bone, used for husking coco-nuts. Cf. soki.
zubnanamiz, zubö-nanamiz (s), *v.* to throng.
zugu (m), *n.* the arm, upper arm; eight in counting on the body; wadegam zugu, twelve, in counting on the body.
zuguba, zugubu (s), *n.* tobacco.
zugukwoik (mb), zugu kuiku (b), *n.* the shoulder.
zŭnga, *n.* a boy or lad before initiation. Cf. karingi, kĕrnge, kaukwik.
zunga, *n.* the name of a tree.
zungri (n), *n.* = zŭnga.
zurana (m), *a.* boiling.

Fig. 1.

Section across west end of the Kimegar, at Holywood, Co. Down.

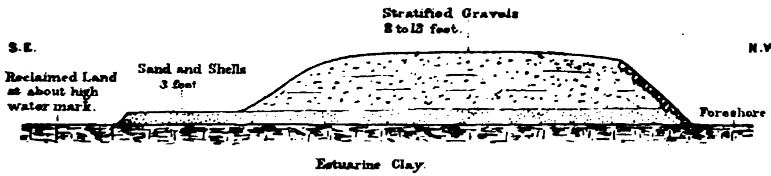


Fig. 2.

Section on the shore at Kilroot, Co. Antrim.

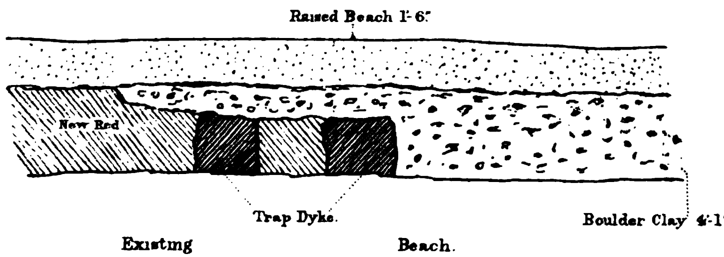
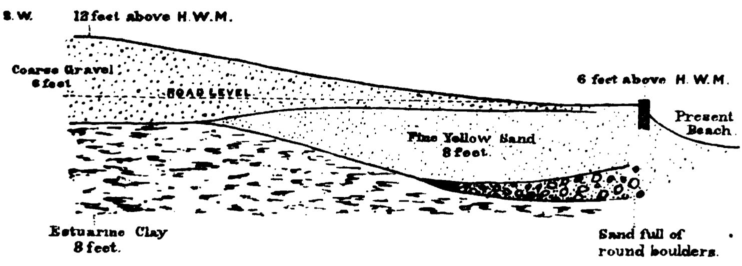


Fig. 3.

Section across portion of the Curran, Larne.



Length of Section, 600 feet.

Geo. West & Sons lith. et imp.

Fig. 1.

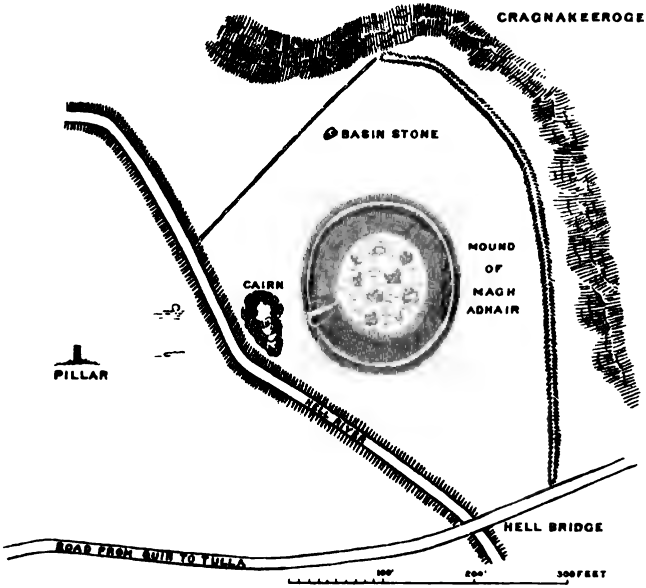
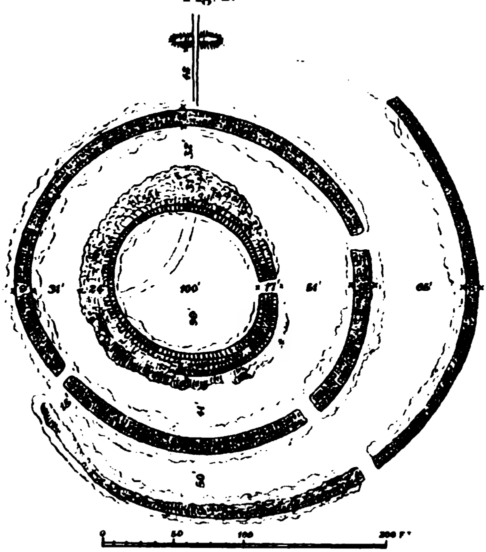


Fig. 2.



Fort of Cahercalla Co. Clare.

Geo. West & Sons lith et imp

Royal Irish Academy.

GENERAL ABSTRACT OF THE ACCOUNTS

FROM

1st April, 1895, to 31st March, 1896.

ROYAL IRIS

GENERAL ABSTRACT OF THE ACCOUNT OF REV. MAXWE

FOR THE YEAR END

RECEIPTS.	£ s. d.			Total of each Class. £ s. d.		
Balance from last Year,	17	4	8	17	4	8
PARLIAMENTARY GRANTS:—						
General grant in aid, ...	1500	0	0	1500	0	0
[For Treasure Trove Account see below.]						
MEMBERS' PAYMENTS:—						
Entrance Fees, ...	57	15	0			
Annual Subscriptions, ...	276	3	0			
Life Membership Compositions, ...	117	12	0	451	10	0
Science Grant returned by Grantee, ...	20	0	0	20	0	0
PUBLICATIONS SOLD:—						
Transactions and Cunningham Memoirs, ...	28	10	3			
Proceedings, ...	2	11	4			
Irish Facsimiles, ...	7	7	0			
Todd Lectures, and Irish MSS. Series, ...	12	12	0	51	0	[illegible]
ANNALS OF ULSTER:—						
Refund by Government, ...	425	12	0	425	12	0
INTEREST ON INVESTMENTS:—						
Life Composition—2¾ per Cent. Consol. Stock, . . .	102	1	4			
Cunningham Bequest—2¾ per Cent. Consol. Stock, . .	70	10	8			
Geological Illustration Fund—2¾ per Cent. Consol. Stock,	14	9	2	187	1	2
	£2652	8	5	2652	8	5

TREASURE TRO

	£	s.	d.
Balance from last year, ...	271	10	11
Grant 1895–6, ...	100	0	0
	£371	10	11

TODD MEMORI

	£	s.	d.
Interest on investments, ...	41	2	6
	£41	2	6

I certify that the above account is correct, according to the best of

ACADEMY.

H. CLOSE, TREASURER OF THE ROYAL IRISH ACADEMY,

31st of MARCH, 1896.

PAYMENTS.	£ s. d.	Total of each Class. £ s. d.
For SCIENTIFIC AND LITERARY PURPOSES:—		
Scientific Reports,	120 0 0	
Library,	294 10 1	
Irish Scribes,	143 0 0	
Printing Preface and Index of Annals of Ulster,	257 0 0	
Do. Transactions and Proceedings and Cunningham Memoirs,	354 11 7	1169 1 8
„ ESTABLISHMENT CHARGES:—		
Salaries,	369 0 0	
Wages and Liveries,	220 5 4	
Furniture and Repairs,	6 10 11	
Fuel and Gas,	60 11 5	
Insurance,	8 2 6	
Stationery,	10 13 5	
Printing (Miscellaneous),	60 2 9	
Postage,	15 18 7	
Freights, Incidentals, and Contingencies,	26 3 4	777 8 3
„ ANNALS OF ULSTER:—		
Paid on Account of Editing and Printing Vol. III.,	425 12 0	425 12 0
„ INVESTMENTS (CAPITAL):—		

	Stock Bought. £ s. d.	Description.	Total Stock. £ s. d.	£ s. d.	Total of each Class. £ s. d.
Life Membership Compositions,	246 12 2	Gov. 2¾ Stock,	4124 12 6	270 18 0	270 18 0
Cunningham Fund,	— —	Do. do.	2653 9 9		
Geological Illustration Fund,	— — —	Do. do.	435 7 4		
Todd Memorial Fund,	— — —	Do. do.	1567 2 3		

	£ s. d.	Total of each Class. £ s. d.
„ Balance to Credit,	9 8 6	9 8 6
	£2652 8 5	2652 8 5

ACCOUNT.

	£ s. d.
Treasure Trove purchased,	42 11 0
Balance to credit,	328 19 11
	£371 10 11

ACCOUNT.

	£ s. d.
Salary of Todd Professor,	40 0 0
Balance,	1 2 6
	£41 2 6

knowledge and belief.—Maxwell H. Close, *Treasurer*, *R.I.A.*—

[*For Auditors' Report see next page.*

AUDITORS' REPORT.

We have examined the above General Abstract, and compared the Vouchers for the details of the several heads thereof, and find the same to be correct, leaving a Balance to the credit of the Academy's General Account of Nine Pounds Eight Shillings and Six Pence, and to the Treasure Trove Account of Three Hundred and Twenty-eight Pounds Nineteen Shillings and Eleven Pence, and to the Todd Memorial Account of One Pound Two Shillings and Sixpence, making in all a Balance of Three Hundred and Thirty-nine Pounds Ten Shillings and Eleven Pence.

The Treasurer has also exhibited to us Certificates in respect of the invested *Capital*, showing that the amounts of Stock standing in the name of the Academy were Two Thousand Six Hundred and Fifty-three Pounds Nine Shillings and Nine Pence, 2¾ per Cent. Consolidated Government Stock, Account A, being the Capital of the "Cunningham Fund"; Four Thousand One Hundred and Twenty-four Pounds Twelve Shillings and Six Pence, 2¾ per Cent. Consolidated Government Stock, Account B, being Capital derived from Life Compositions; and Four Hundred and Thirty-five Pounds Seven Shillings and Four Pence, 2¾ per Cent. Consolidated Government Stock, Account C, being the Capital of the Geological Illustration Fund. Like Certificates have been exhibited to us showing a sum of One Thousand Two Hundred and Nine Pounds Eighteen Shillings and Four Pence, 2¾ per Cent. Consolidated Government Stock, in the Court of Chancery, and a sum of Three Hundred and Fifty-seven Pounds Three Shillings and Eleven Pence, 2¾ per Cent. Consolidated Government Stock, standing in the name. of Trustees, which together form the Invested Capital of the "Todd Memorial Fund.'

(Signed), W. REYNELL, HENRY KING, *Auditors.*

17th April, 1896.

THIRD SERIES.] [VOL. IV.—No. 1.

CONTENTS.

Dublin: Printed at the University Press, by PONSONBY & WELDRICK, Printers to the Academy.

APRIL.] [1897.

PROCEEDINGS

OF THE

ROYAL IRISH ACADEMY.

THIRD SERIES.

VOLUME IV.—No. 2.

DUBLIN:
PUBLISHED AT THE ACADEMY HOUSE, 19, DAWSON-STREET.
SOLD ALSO BY
HODGES, FIGGIS, & CO. (Ltd.), GRAFTON-ST.;
And by WILLIAMS & NORGATE,
14, Henrietta-st., Covent Garden, London; 20, South Frederick-st., Edinburgh;
and 7, Broad-st., Oxford.
1897.

XI.—SKETCH OF DAUDAI GRAMMAR.

The materials available for the elucidation of Daudai Grammar are of the most meagre and scanty description. They comprise: (1) A few notes in the Rev. E. B. Savage's Vocabulary of Murray, Mabuiag, and Daudai (MS. 7). (2) Some phrases and sentences at the end of Sir W. MacGregor's Kiwai vocabulary (22). (3) A few sentences and hymns printed for Mission use, by Rev. E. B. Savage. We believe that as a matter of fact the translations were partly due to a Miriam native teacher. The greater part of the latter is printed in the Specimens of the Daudai Language.

It is very evident that what is known of Daudai Grammar has been obtained by means of the Miriam language. The Rev. E. B. Savage's Vocabulary has the Miriam, but no English equivalents to the Daudai words, whilst the translation and hymns correspond word for word, and often inflexion for inflexion with the Murray versions. For these reasons it is obvious that too much stress cannot be laid upon the accuracy of what is here set forth, and much is certainly left for further explanation and exhibition.

In this sketch notes taken from MacGregor are marked (K), those from Savage's MS. are marked (KS).

DIALECTS.

The words given in Savage's MS. represent the western portion of the district in which the Daudai language is spoken, though some words are marked as representing the dialect in use at Perem (Bampton Island) or at Kiwai. The vocabularies of D'Albertis and Beardmore represent the language about the mouth of the Binature or Katau river, especially of the village of Mowat (Moatta or Mouatta). MacGregor's vocabulary was "drawn up chiefly at the village (on the Island of Kiwai), usually called 'Kiwai,' but named by its own people 'Iăsa,' and is "used by aboriginals of Ipisia, Saguana, Samari, Mabudamu, Auti, Wiorubi, and Sumai villages."[1]

"With dialectic differences, the language is understood all over the Island of Kiwai, and round the coast as far as the Mai Kŭsa, and for

[1] Annual Report on British New Guinea, 1890, p. 124.

Royal Irish Academy.

GENERAL ABSTRACT OF THE ACCOUNTS

FROM

1st April, 1895, to 31st March, 1896.

The instrumental forms of the pronoun do not appear. MacGregor has *nimo-sirio, nigo-sirio*, we all, you all.

(*b.*) *Accusative.* The objective or accusative case does not differ from the nominative except in its position in the sentence.

(*c.*) The *Genitive* or *Possessive* case is irregularly formed.

Singular, 1. *mo-ro;* 2. *ro-ro;* 3. *nou-na.*

Dual or plural, 1. *nimo-ta, nimo-na, nimo-ibi-na;* 2. *nigo-nai;* 3. *nei-nai.*

Ro does not appear as a possessive suffix elsewhere in Daudai. I, may be compared with the Miriam *ra.* The suffix *na* in *nou-na. nei-na, nimo-na* is the same as that used with nouns. The plural forms *nimo-ta, nimo-ibi-na, nigo-nai, nei-nai* are given by Savage who also has a 3rd dual, *neito-nai. Nimona* is only found in the text. MacGregor gives *oro* as well as *roro*, for thy; *oro tu*, thy hand; *oro epuru*, thy head. In the plural both MacGregor and the text have the simple form of the pronoun as a possessive. *Nimo kigiro*, our life; *nimo tu* (K), our hands; *nigo moto*, your house.

(*d.*) The *Dative* of the personal pronouns is shown by the suffix *-gido.* This is usually added to the possessive of the first and second persons singular, and to the simple forms of the other pronouns. It is translated "to" or "for," and in some phrases is difficult to distinguish from an accusative.

Singular, 1. *moro-gido, mo-gido;* 2. *roro-gido, ro-gido;* 3. *nou-gido.*

Plural, . 1. *nimo-gido;* 2. *nigo-gido;* 3. *nei-gido.*

Ro mogido uosa, thou givest to me; *nimo noboi rogido erudomoti*, we here pray to thee; *gesona nougido sibomuguruti*, good (it is) to believe on him; *nei nougido orirai ouato satauro*, they hanged him on the cross; *nou nimogido uarabai*, he helps us; *Mose emetiodoi neigido*, Moses commanded to them.

Some sentences given by MacGregor are:—*Moro gido oosa, roro* (*gido*) *oosa, nou gido oosa.* These are translated—I give you, thou givest you, he gives you, etc. In the plural—*nimo gido oosa, nigo gido oosa, nei gido oosa.* The first two of these agree with the above if divided, *mo rogido oosa, ro rogido oosa*, but the remainder present a difficulty, *gido* being used as if a pronoun, "you."

(*e.*) The *Ablative* is shown by the suffix *-gaut*, from. In the first and second person singular it is joined to the possessive form.

Singular, 1. *moro-gaut;* 2. *roro-gaut;* 3. *nou-gaut.*

Samuito lepera-tanar oritorai nougaut, quickly the leprosy departed from him. This is the only example found.

(*f.*) The *Ergative* is shown by the suffix *-gomoa*, which corresponds in meaning to the Miriam *-dog* and Saibai *-bia*, and may be translated "with." The suffix is added to the possessive in first persons.

Singular, 1. *moro-gomoa;* 2. *ro-gomoa;* 3. *nou-gomoa, no-gomoa.*

The only example is:—*Eberiti uaramai numabu, nougomoa numabuia*, take away the false thing, with him (is) the real thing.

(*g.*) The equivalents of the Miriam *karababu, mabu, tababu* are expressed in Savage's MS. by means of the word *imarai*, joined to the personal pronouns.

Mo-imarai, myself; *imarai*, thyself; *no-imarai*, himself. In the text:—*nou noimarai kigiro*, he himself is life.

The MS. also gives *simarai*, himself, but, in the text, *simera* is "yourself." *Oguitogu! simera arapoi nougido muguru buaraigo*, Go! show yourself to him the sacred chief.

2. Interrogative Pronouns:

The personal interrogative is *Botur?* who? (MacGregor, *beturo?*) This is declined like the personal pronoun *nou*. *Botu-na?* whose? *botugido?* to whom? Who? is used in asking a person's name as in the Melanesian languages. *Ro paina ro beturo?* or, *Ro paina beturo?* who is your name? (K). Savage has however *Bedar roro paina?* what is your name?

What? is *ebeta? beda?* or *bĕdar?* MacGregor gives also *boro*, and *nunamabu*, and the examples: *Nebeta, nebetaro?* what is this? *Nebetarerearo?* what is that? *Beda mutu noosari?* what do you want for this? *beda didiri rogu?* what man comes? *Ebeta* is declined, *Ebito-gido?* for what? why?

The only example in the text is—*Bedar roro paina?* what is thy name?

3. Demonstrative Pronouns and Adjectives:

The MS. does not distinguish between the nearer and remote demonstratives this and that, but the words given are *goina, goi noina*. *Abara, abra*, now, appears as a demonstrative equivalent to "this" in *abra-sai* (K), to-day; *abra-duo* (K), to-night. Cf. Miriam, *abele*.

MacGregor has *tatari*, this, but the word is properly an adverb, "near." He also gives *gido, mosia*, that.

Nou tau goina arago (KS), he said this; *goina tau iporigai* (KS), that is finished; *sirio arubi nougido ogu goi dirimorogaut* (KS), many men came to him from that country.

4. INDEFINITE PRONOUNS AND ADJECTIVES:

Ata, natüra (K), another; *gotaonaosa* (K), each; *beturo* (K), some others; *nirubiro* (K), any one; *arua* (KS), some; *naüto nari* (K), all the same; *sirio*, many, plenty.

§ III.—*Nouns.*

1. NOUN FORMS.—A verb may be used as a noun without change of form. *Nou kigiro*, he lives; *nimo kigiro emadi*, our life (he) bought.

In Mark i., 44, the ablative suffix *-gaut* is used to form a noun in *karadabuti-gaut*, a sign. The whole phrase, however, in which it occurs corresponds so closely to the Miriam, that it is probably a mere imitation and not an idiom.

Cf.	*Karadabuti-gaut ro tau dodiai,*
with	*atame-lam mama emetu idigiri.*
	sign thou finish heal.

Adjectives when used as substantives appear to have a terminal *na*. *Geso*, good; *gesona*, a good thing; *durupi geso numabu, gesona uaito uagoria*, the body is a good thing, (it is) good (to) carefully look after it; *gesona nougido sibomuguruti*, good (it is) to believe on him; *geso ouera*, a good word. The demonstratives *goi, goina* show the same distinction.

The persons performing an action or possessing a quality are indicated by the words *dubu*, man, or *arubi*, people, following or preceding the verb or adjective. *Abidiru dubu*, an oarsman; *koropa arubi*, sick people; *arubi uibu*, black people. So also in MacGregor's list of tribes *Kadowarubi, Katau* people; *Tudorubi*, Tud people; *Aitarubi, Dararubi* etc.

The suffix *idai* is also found with names of people, and may be the Saibai *idaig*. Cf. in MacGregor's list: *Dawanidai*, Dauan folk; *Bigomidai*, Boigu folk; *Saibodai*, Saibai folk. A few words show the Saibai *laig* in the form *raig*. *Moaraigo*, Moa people; *Badaraigo*, Badu, people.

Many words in the list of tribes end in *darimo*. This is probably the word *dirimo*, land. Hence, *Dawaredarima*, Dauar land; *Nakidarimo*, Nagir land; *Baramodarimo*, Perem land, etc.

2. NUMBER.—The dual is shown by the numeral *netoa*. *Moro tuo netoa, moro airo netoa,* your two hands, your two feet.

MacGregor states that in Kiwai the plural is sometimes formed by adding *ro* to the singular. Some words in the vocabularies to which a plural meaning might be assigned end in *ro*, though they are not given as plural. Such words are *dirimoro* (KS), *dirimo* (K), land; *dodo* (K), beach, shore; *dodoro* (K), coast.

In the text the plural is formed by the word *mabu* following the noun. *Mabu* literally translates the Miriam *giz*, and has the same meaning of "origin or foundation." *Iuio mabu*, days; *koimi mabu* (Mir. *kaimeg giz*), disciples.

The adjectives *sirio* and *rorodia* are also used to express the plural. *Sirio arubi a numabu*, many men and things; *sirio tanar*, every act.

Some nouns appear to have an irregular plural. *Dubu*, a man; *arubi*, *didiri*, men; *orobo*, a woman; *upi*, women.

These methods of expressing the plural are sometimes combined. *Iwio mabu rorodia*, all the days; *sirio sai mabu* (K), many days; *arubi mabu keake a arubi uibu, arubi numabutato a sirio buaraigo*, white men and black men, poor men and chiefs.

3. GENDER.—There is probably no gender. There are no examples of the method of distinguishing sex.

4. CASE.—The noun is declined by means of suffixes. The cases found are the Nominative, Accusative, Genitive, Dative, Ablative, and Locative.

(*a*) *Nominative*.—This is the simple form of the noun.

(*b*) The *Accusative* does not differ in form from the Nominative, but is known by its position following the verb. *Oradubu atauti sirio numabu*, God made many things; *nou dodiai sirio koropa arubi*, he healed many sick men.

Often, however, the accusative precedes the verb as in Miriam and Saibai. *Kigiro agiuai*, give life; *moto odoro*, enter the house; *wadura waopo*, prepare the pipe.

(*c*) The *Genitive* or *Possessive* is shown by the suffix *-na*. *Oradubu-na mere*, God's son; *Iesuna ouera*, Jesus' word; *girop-na numabu*, thing of the heart; *didiri-na ouera*, men's word.

(*d*) The *Dative* is formed by the suffix *-to* or *-ito*. Savage's MS. gives *ou-to* for Mir. *kotor-em*, to heaven; *opu-ito*, to the world, Mir. *geseb-em*; *mauro-ito*, to a place; Mir. *uteb-em*.

In the text, *Nimo nau oputo aue iuio Sabath,* we to one place come great Sabbath day. In MacGregor, *oromoito,* to deep water; *potoito,* to shallow water. The suffix *-gido,* used with pronouns, is found with Proper nouns also. *Ogu Iesugido,* come to Jesus; *erudomoti Iesugido,* pray to Jesus.

(*e*) The *Ablative* is shown by the suffix *-gaut,* from. *Opu-gaut,* from the ground; *sobo mere-gaut,* from a little child; *roro zugu moto-gaut,* from thy holy house; *sirio dirimorogaut,* from many lands; *Oradubu na mere ougaut ororua,* God's son came down from heaven; *uba tanar eberiti nimogido girop-gaut,* bad deeds take away for us from the heart; *sirio darubi a numabu nouna tuogaut,* many men and things (are) from his hand.

(*f*) The *Locative* appears to be formed by the suffix *-ato.* It is apt to be confused with the Dative.

Iesu ouato omiei, Jesus dwells in Heaven; *poputo omiei,* to kneel, rest on knees; *nou teapariato omiei,* he stayed in a barren place.

§ IV.—*Adjectives.*

1. Many adjectives are used in a simple form as *uba,* bad; *eke,* small; *geso, wade,* good; *auo,* big.

2. Adjectives are formed, as in Miriam, by the reduplication of a noun. *Tamatama,* thin, skinny, from *tama,* skin; *ipuipu,* dirty, from *ipua,* dirt; *ururu,* deep, from *ur,* sea.

In many cases the root of a reduplicated adjective is not separately found. *Boroboro,* rotten; *gabugabu,* cold; *kobokobo,* weak; *umumue,* whole, entire; *torutoru,* easy.

The usual effect of reduplicating a simple adjective is to intensify the meaning. *Ekeburi* (K), little; *ekeburiekeburi* (K), very little; *auo,* big; *auoauo,* very big.

3. Adjectives expressing the negation of a quality are formed by the suffix *-tato,* which corresponds in meaning to the Miriam *kak,* Saibai *igi. Kawikawi,* crooked; *kawitato,* straight, not crooked; *iuaitato,* dislike; *numabutato,* poor, no things.

Some times the ordinary negative *pua* is found instead of the suffix. *Adina pua* (M), bad, not good.

4. The suffix *-na* seems to form a noun from an adjective. See Nouns, 1.

5. Adjectives are also found with a suffix *-imi,* but the meaning is

not clear. It often appears with adverbs. *Dogo, dogoaimi, doguaimi*, yet, still, continually; *sopuimi*, short; *tagara, tagaraimi*, old; *tuturu, tuturuimi*, all; *natura, naturaimi*, another; *sobo*, small; *sopuimi*, short, low.

5. There is a kind of adjectival suffix, *ia*, which gives the meaning of "real, true, or very," when added to a noun. *Oradubuia*, real or true God.

§ V.—*Verbs*.

1. Most verbal roots commence with a vowel. When they do not so commence, it is probable that a prefix is present or that the word is a compound.

2. VERBAL FORMS:

(*a*) *Causative*. There is one example in the hymns of a causative formed like the Miriam by means of the dative suffix. This is the word *erapo-ato*, to make strong, from *erapo*, strong.

(*b*) *Negative*. The Negative is indicated by the adverb *pua, pai*, or *puai* not, preceding the verb. *Sai puai emereuti*, sun does not shine; *puai oroto*, not cry; *pai karamarago*, not scold; *nimo pai korio*, we do not play.

(*c*) *Interrogative*. This is shown only by the use of the Interrogative pronouns or adverbs.

(*d*) *Quotations*. The word *gebo* is the equivalent of the Miriam *kega*, Saibai, *keda*. *Nougido arago, gebo, moro diriuo, ro dodiai*, said to him, thus, my wish, thou (art) clean.

(*e*) There is no substantive verb.

3. There is very little data for the study of the moods and tenses of the Daudai verb. MacGregor gives some forms for the Kiwai with the remark that "the inflection of verbs is apparently complicated, and is not mastered." A few notes are found in Savage's Vocabulary. Others may be gathered from the text. All these show that the verbal root is modified by prefixes and suffixes to express variations of mood, time, and number.

4. MOOD:

(*a*) *Imperative*. This does not appear to differ from the indicative. *Uaito damari!* carefully consider! *Oguitogu*! go! So also the prhiobitive: *Puai arago ata didiri!* don't tell any man! *Toretato!* fear not!

(*b*) *Infinitive*. The infinitive is shown by the word *no* preceding the verb. *Nou nimogido uarabai no geso tanar auagati*, he teaches us

to do good actions; *nimo nauoputo no erudomoti*, we assemble to pray; *nimoibina girop omiei no uba tanar eberiti*, abide in our hearts to take away bad deeds.

(*c*) *Desiderative.* A wish is expressed by *diriuo*, *Mo diriuo emoputi roro geso tusi*, I wish to read your good book; *nimo diriuo kigiro*, we wish to live.

The negative is *diriuotato*, or *pai diriuo*. *Iesu pai diriuo nimo no oriai*, Jesus does not wish us to die.

(*d*) *Potential.* A kind of potential is expressed as in Miriam by the word *umoro*, to know how; in the negative, *umorotato*. *Iesu umorotato tamai airogu goina dirimorogaut*, Jesus could not openly walk about that country; *mo umorotato*, I cannot.

(*e*) *Subjunctive and Conditional.* These are indicated only by the conjunctions.

5. TIME:

In Savage's MS., and in the text, the verbs undergo no change to indicate Tense. MacGregor gives the verbs go, give, eat, and preach, in Present, Past, and Future. An analysis of his examples shows as follows:—

(*a*) The *Present* is the simplest form of the verb. *Oosa*, give; *ogu*, go; *iriso*, eat; *totomo auera*, preach.

(*b*) The *Past* has the prefix *n*-, in all persons and numbers:—

Mou duduata nogu,	*Nimo duduata nogu*,	I, we went.
Rou duduata nogu,	*Nigo duduata nogu*,	Thou, you went.
Nou duduata nogu,	*Nei duduata nogu*,	He, they went.

Moro gido sukuba tao noosa,	I gave you tobacco.
Roro nori tao niriso,	Thou atest sweet potatoes.
Moro totoma tao nauera,	I preached.

In these examples *duduata* is a noun "yesterday," and *tao* a verb "finish."

(*c*) The *Perfect* is shown by the verb *tao*. Savage uses *tau* to form a past, and also as a separate verb, "to finish." MacGregor has *tao* with all the examples of *oosa*, *noosa*, in the past. *Nou gido sukuba tao noosa*, he gave you tobacco, etc., and also with the verbs "to eat, preach." See examples above.

The text has: *Nou tau ogu*, he has come; *goina tau iporigai*, that is finished; *nou tau edea nouna numabu*, he has put down his things.

(*d*) The *Future* is shown in MacGregor's examples by the suffix *-ri*.

Nou gido sukuba dogo oosari, he will still give you tobacco; *nimo gido sukuba dogo oosari*, we will still give you tobacco.

With the verbs "to eat" and "to preach," the suffix *-ri* is used with the prefix *n-*. *Moro nori dogo nirisori*, I will still eat sweet potatoes; *moro totoma auera dogo narogori*, I will preach, I will preaching word still say.

In the singular number of these verbs "eat" and "preach" MacGregor's examples have the forms *moro, roro*, instead of *mōu* and *rōu*.

In the text the particle *no* seems to mark the future. *Nimo no oguitogu*, we will go! *Iesu pai diriuo nemo no oriai*, Jesus does not wish that we shall die. Cf. Remarks on Infinitive Mood.

(*e*) *Continuance* of an action is shown by the word *dogo*, yet, continually. *Nei dogo aue amadi*, they continually rejoice; *dogo opito*, gradually grew up. See also examples in future (*d*).

6. NUMBER AND PERSON:

Some verbs are marked as plurals in Savage's Vocabulary, but they are so few that they cannot be classified.

Sing. *aidimai*;	Plur. *aradimai*, to cover.
,, *aru*;	,, *iboriti*, to sow.

In MacGregor's example of the verb "to go," there appear prefixes varying with the number and person of the verb. Thus *ai*, *ogu*, meaning go; *abrasai* and *doguaimi*, to-day; *duduato*, yesterday; *dudua*, to-morrow, we have the following:—

Present:

Sing.—1. *Mou abrasai doguaimi* nai.	Plur.—1. *Nimo abrasai nimairi.*
,, 2. *Rou abrasai doguaimi nai.*	,, 2. *Nigo abrasai imairi.*
,, 3. *Nou abrasai doguaimi* nai.	,, 3. *Nei abrasai vimoguiri.*

Past:

Sing.—1. *Mou duduata nogu.*	Plur.—1. *Nimo duduata nogu.*
,, 2. *Rou duduata* nogu.	,, 2. *Nigo duduata nogu.*
,, 3. *Nou duduata nogu.*	,, 3. *Nei duduata nogu.*

Future:

Sing.—1. *Mou dudua nai.*	Plur.—1. *Nimo dudua nimairi.*
,, 2. *Rou dudua wairi.*	,, 2. *Nigo dudua imairi.*
,, 3. *Nou dudua nairi.*	,, 3. *Nei dudua vimairi.*

Probably with a fuller knowledge of the language the exact meaning of these variations may be explained.

7. DIRECTIVES:

It is probable that certain particles are used as directive prefixes, but their exact determination is difficult.

Oro, down. *Orodobi*, to set (of the sun), go down; *ororua*, come down; *orogurio*, to blow; *oromiado*, to sit down. (D'Albertis has *omia*, to sit, and *omiei* in other vocabularies is given for stay, remain.)

Ori, up. *Oriboa*, to stand up.

Oto, away. *Otoboa*, to leave; *otumai*, to send away; *otoai*, to cut down (away). MacGregor has *auto-ogu*, go away.

Cf. *otigi*, to put out; *otoi*, to leave; *ototoro*, to tear; *otaauti* (K), to divide.

Benu. *Benupedudi*, to believe; *benumuguruti*, to repent.

8. Suffixes:

Certain syllables are commonly affixed to verbs which sometimes appear without them, and hence they must be regarded as suffixes. Such syllables are *ti*, *di*. *Aratoro*, *arotoridi*, ask; *arogo*, *aroguti*, speak; *auodi*, *auoduti*, pour; *bodoro* (Mir. deskemer), *bodorodi* (Mir. deskemereda), persecute.

There is also an appearance of suffixes in the words *aurai*, *auaruo*, to prick, sew; *epuruo*, to hide; *emereuis*, to scorch; *emereuti*, to light up.

Several verbs denoting mental operations end in *diro*. *Erauidiro*, *iroidiro*, *mitidiro*, to hear; *kitamodiro*, to teach; *atamudiro*, to interpret (*atamuai*, teach); *meragidiro*, *emeragidiro*, to remember, think. *Iroruodiro* is "to drown."

9. As an example of the variety of verbal forms we give the verb *ogu*, go, as it appears in the vocabularies. Unfortunately, the compilers of these have rarely given the exact shades of meaning.

(K). *Auto-ogu*, go away; *au-ogu*, bring; *butāū-ogu?* where are you going? *ogu*, come, walk; *im-ogo-rumo*, to beckon to come; *ragot-ogo*, to beckon to go; *rogo*, go; *wiroguri*, he comes; *nitariguro Kanani*, Kanani comes.

(Savage MS.) *Aguitogo*, go (Mir. *kei bakeam*); *air-ogu*, walk; *arogoto*, go; *guit-ogu*, go; *kim-ogu*, bring; *n-ogo-dumo*, go; *ogu*, go; *ogu-nita*, go, (Mir. *kei tabakeam*), *ogu-itogu*, gone; *ogu-nita*, came.

(D'Albertis). *Agoitogo*, walking; *nitago-ogo*, coming.

§ VI.—*Adverbs*.

1. Interrogative:

(*a*) *Place*.—*Boro?* where? *Buaraigo boro?* Where is the chief? *Gabo boro?* Where is the road?

MacGregor also has: *Pe boigaro ogu?* Where has the boat gone? *Butaūogu?* Where are you going?

(*b*) *Time.*—*Bedaiuio?* When? What day?

(*c*) *Cause.*—*Ebitagido?* Why? What for? *Ebitagido nou oriai?* Why did he die?

(*d*) *Number.*—*Bedamota?* (KS), *bedamutu?* (K). How much? How many?

The word *bedar* or *beda* (K) translates the Miriam *nako?* *Beda didiri rogu?* What man comes?

2. PLACE:

Naitawatawa (K). here; *noboi rom* (K), here; *gonou*, there (Mir. *dali*), *noboi*, there (Mir. *penoka*); *nebetaromi* (K), there; *gido* (K), further; *gaime*, distant; *giatoa* (K), distant; *mureso*, far off; *uru, uru apuo*, out of sight; *uapureto*, next; *taugo* (KS), first; *dogobe*, round; *eregetei* (K), downwards; *uege*, back, alongside; *osua* (K), upwards.

3. TIME:

Abara, now; *oiti*, then; *duduo*, to-day; *abrasai* (K), to-day; *abraduo* (K), to-night; *duo*, in the night; *araporio*, near sunrise; *duduēri*, *duduaere* (K), in the morning; *duduo sai* (K), to-morrow; *waraoit or uaro-ito* (M), to-morrow; *dogo, dogoaimi* (K), by-and-by; *duduata, duduata sai* (K), yesterday; *duotau* (M), yesterday; *duomutu* (K), day before yesterday, day after to-morrow; *duatata*, on the third day; *tagara, tagaa* (M), for a long time, long ago; *nanito*, always; *iporigaitato*, unending, for ever; *sai siro*, every day, daily.

4. MANNER:

Dopi, likewise, also; *dogo*, yet, continually; *mina*, again, always; *garigari*, in vain; *menae*, secretly; *uaito*, carefully; *naturai*, only; *nouororo*, like; *tamai*, openly.

§ VII.—*Postpositions and Local Nouns.*

1. The use of the simple postpositions, used as suffixes, have been illustrated in the sections on Nouns and Pronouns.

They are *ro, na*, of; *gido, to, ito*, to, for; *gaut*, from; *ato*, at, in; *gomoa*, with, by.

2. As in Miriam and Saibai, some nouns are used with suffixes to indicate positions. Those found are: *ou*, sky, top; *niro*, inside; *iri*, back; *magumo*, bottom; *tatari*, a place near; *turi*, middle. They appear as *ouato*, above; *niroato*, in the inside; *iriato*, under; *irito edea*, put behind; *magumoato*, under; *tatarito*, to near; *turiat*, among, between. *Sito*, outside, is probably a word of the same kind.

3. Other words given in the vocabularies as equivalents of the

English prepositions are: *Apuo*, beyond; *goboromi*, at; *paa*, *paha*, with, in company of, equal with; *pope*, along with, equal to; *ro*, with; *sugu* (P), outside; *wabutu*, behind. *Uagediai*, around, is also a verb, to surround.

§ VIII. *Conjunctions.*

1. *E*, also, and; *nuairomi*, whether, or; *numada*, if; *goinagaut*, from this, because, for; *gebo*, thus, saying; *gedagebi*, *gedogibo* (K), so, like, as.

§ XI.—*Exclamations.*

Ie! yea! *Iyvăuŏ!* (K) Farewell!

§ X.—*Syntax.*

Words seem to be arranged as in Miriam and Saibai, but the texts available are too scanty to afford much guidance.

§ IX.—*Numerals and Measures.*

1. NUMERALS.—Only two distinct numerals appear to be in use. These are: *nau*, *nao* (K) one; and *netau*, *netoa*, or *netewa* (K) two.

MacGregor gives them repeated for higher numbers, thus: *Netewa nao*, three; *netewa netewa*, four; *netewa netewa nao*, five; *netewa netewa netewa*, six; *netewa netewa netewa nao*, seven; *netewa netewa netewa netewa*, eight; *netewa netewa netewa netewa nao*, nine. For ten and numbers above he also gives *modoboima*, *modoboima nao*, etc. In these *modoboima* is probably a hybrid word composed of the Motu *ima*, hand or five, and the Daudai word *modobe*, to complete. It would thus mean the hands or the finish of the hands, *i.e.* all the fingers.

Savage's MS. has *potoraimi*, four.

The English numerals will no doubt be introduced. *Thri* for "three" is used in the text.

2. MEASURE.—The only unity of length is the fathom, *dodobu*, measured as in Miriam.

§ XII.—*Points of the Compass.*

These are given thus:—

N. or N.W., *suroma* (K), *uramo* (M).
S. *sie-raragoro* (K).
S.E. *uroa* (M), *susu-rarugoro* (K).
S.W. *sia* (K).
E. *dibiri-duba* (K).
W. *sie* (K), *irara-sukumai* (K).

XII.—SPECIMENS OF THE DAUDAI LANGUAGE.

1.—THE HEALING OF THE LEPER.

(*Mark*, *i*. 40–45.)

(*From the Rev. E. B. Savage's translation.*)

40. Nougido ogunita ata *lepera*, a poputo omiei, a
To him came a certain leper and on knee sits and

nougido arago, gebo, numada ro diriuo, ro umoro mogido
to him ask thus if thou wish thou can me

dodiai.
heal.

41. Jesu nougido nirimogari, a tuo otuturo, a nougido
for him pity (had) and hand stretches out and him

orogiama, a nougido arago, gebo, Moro diriuo; ro dodiai.
touches and to him says thus My wish thou heal.

42. Nou tau goina arago, samuito *lepera* tanar oritorai
He finish this saying quick leper fashion rises up

nougaut, a nou dodiai.
from him and he is healed.

43. Jesu nougido emeteodoi, a nougido ĕmĕriai, a nougido
to him commands and him sends away and to him

arago, gebo.
says thus.

44. Uaito damari! puai arago ata didiri; oguitogu!
Carefully look not speak another person go

simera arapoi nougido muguru buaraigo, a agiuai irio
thyself show to him holy chief and give food

numabu *Mose* emeteodoi neigido; karadabutigaut ro tau
thing Moses commands to them a sign thou finish

dodiai.
heal.

45. *Lepera* oguitogu, a mabuedea no ouera arago, a
Leper goes and begins to word say and

arago uagediai; goinagaut Jesu umorotato tamai airogu
says around through that cannot openly walk

goina dirimoro; nou teapariato omiei, a sirio arubi nougido
that country he in barren place stays and many men to him

ogu goi dirimorogaut.
came that country from

2.—Oradubu.

(*From the same as preceding.*)

Oradubu atauti sirio numabu—sai, a uoog, a opu, a
God makes all things day and animals and earth and

ou, a oromobo, a didiri. Nou noimarai kigiro. Ata didiri
sky and sea and man. He himself life. Other man

pai atauti, umorotato. Sirio arubi, a numabu nouna tuogaut.
not make cannot. Many men and things his hand from

Nou iributi arubia, a sirio tanar opuato. Nou nimogido
He takes knowledge of men and all doings on earth. He us

auo nirimogari. Nouna mauro ouato. Nou pai diriuo,
greatly loves. His dwelling in sky. He not wish, like.

gumasa tanar. Nou dogo meragidiro arubi rorodia, a
bad actions. He continually remembers men all and

neigido agiuai aue geso numabu, giropna numabu. Nou
to them gives many good things of heart thing. He

uaito erauidiro didirina ouera kudu. Nou Oradubuia.
carefully hears men's speech. He True God.

Gesona nougido sibomuguruti. Baba eso! Nimo au amadi.
Good thing to him to believe. Father thanks. We greatly rejoice.

3.—Jesu.

(*From the same.*)

Jesu Oradubu na Mere. Tagara, nou ororua opuato, no
Jesus God's son. Formerly he came down to earth to

arapoi Oradubu na gabo. Nou dogo omiei sirio urato,
show God's path. He remained stayed many year

sobo meregaut. Nou erhaigiri Bethlihem, a dogo opito.
little from child. He was born and gradually grew up.

Pai uba tanar auagati. Nou dodiai siro koropa arubi—
No bad action did. He healed many sick persons

togiri, damaruperi, a sirio durupi tematema. Uba arubi
shaking blind and many bodies sick. Bad men.

nougido opio para *Saturo*. Uapureto, *thri* sai, nou mina
him struck dead cross. Afterwards three days He gain

kigiro oritorai, a ioro ouato. Ebitagido, nou orichiai? No
life rose and ascended to heaven. Why he die. To

eberiti nimo gŭmasa mabu. Nou nimogido uarabai no geso
put away our evil nature (origin). He us helps to good

tanar auagati. Gesona nimo uaratai.
actions do Good thing we pray.

4.—SIRIO POHO.

(*Hymns. From the sheet of Hymns. Bibliography, No.* 20. *For comparison, the corresponding Miriam version is added from the Hymn-Book, No.* 13.)

	Daudai.		*Miriam.*
	2. ERUDOMOTI.		90. SABATH.
1.	Baba, nimo noboi, *Father we here*	1.	Baba, keriba ike,
	Rogid erudomoti: *to Thee pray*		Marim esorerapar:
	Ro pai araribia, *Thou not put out*		Ma nole ki imuda,
	Nimo diriuo kigiro. *We wish life.*		Ki edede lagelag.
	Ro nimo mitidiro, *Thou us hear*	2.	Ma keribi asoli
	Nimo roro uaratai *We Thee pray*		Keribi mare damos
	Au numabu midobo, *Great thing suitable*		Gaire lu abkoreb
	No nimogido uagori. *to for us care for.*		Ko keribi nagri
	Nouna Oboro Zugu *His Spirit holy*	3.	Ma keribi ikuar
	Nimogido agiuai, *to us give*		Mara Lamar Zogo
	Nimogido erapo *us strong*		Ko keribi saserim
	Iuio rorodia. *days all.*		Gaire geregere.
	Nouna gabo arapoi *His path show*	4.	Mara gab natomelu
	Nimogido arubi; *for us men*		Keribim uridili
	Uareuo nimo girop, *Open our heart*		Diski keribi nerkëp
	Roro ouera mitidiro. *Thy Word hear.*		Ko mara mer asoli.

5. Orodai Ouato.
Meeting Above.

Nimo dogo au amadi
We still greatly rejoice

Iesu na ouera
Jesus's Word

Arubi girop uarui
men heart turned

Uba eberiti.
bad taken away.

Tau Iesu nirimogari
Finished love

Ouato Satauro,
on cross

Sirio nouna koimi
all His followers

Orodai ouato.
meet above.

Numada nimo koropa,
If we sick

Aue tematema,
great pain

A nimo iuaitato
and we not like

Goina opuato,
(to be) this land in

Nimo dogo au amadi,
We still greatly rejoice

A Iesu au eso,
and greatly thank

Goinagaut nimo umoro
because we know

Orodai ouato.
meet above.

Arubi maibu keake,
Men white

A arubi uibu;
and men black

42. Uiaba ko obapit kotor ge.

1. Meriba au sererege
Ade ra mer nagri,
Le la nerkëp depegili
A uite giz adem.
Emetu Iesu erapei
Tumeme satauro
Gaire abara uerem
Obapit kotor ge.

2. Ese meriba gimegim
A au asiasi
A meriba obogai
Abele geseb ge;
Meriba au sererege
A esoao Adim,
Abelelam meriba ko
Obapit kotor ge.

3. Gaire kakekake le
Pako golegole;

Arubi numabutato,
men poor
A sirio Buraigo.
and many chiefs.
Nei Oradubu na mere
They God's Son
Sibomuguruti,
believe.
Sirio dirimorogaut,
many lands-from
Orodai ouato.
meet above.

Puai oroto noboi,
Not cry there
Pai karamarago;
not scold
Nei puai durugeri,
they not hungry
Puai tematema.
not sick.
Nei dogo aue amadi,
They still greatly rejoice
Sirio sai mabu,
every day
Sirio Iesu na mere
All Jesus's children
Orodai ouato.
meet in heaven.

9. IESU ORORUA.
Jesus came down.

1. Oradubu na Mere,
God's Son
Ougaut ororua,
from heaven came down
No kigiro agiuai
to life give
Arubi rorodia.
men all.

Gaire le nole lu kak
A gaire Opole;
Uiaba Iesu ra uerem
Gaire gedelam,
Uiaba uridili ko
Obapit kotor ge.

4. Nole ezoli abele,
Nole ataparet,
Uiaba nole uererege,
Nole asiasi;
Uiaba au sererege
Gaire gereger,
Gaire Iesu ra uerem
Obapit kotorge.

24. IESU ADE RA UEREM.

1. Iesu Ade ra Uerem,
Kotolame uatabu,
Ko edede nakuare
Le gize uridili.

2. Au tanar kauitato
Great actions right

Iesu uaito arapoi;
carefully show

Nou nimogido uosa
He to us gives

Nouna geso jauali.
His good Book.

3. Nou satauro oriai,
He cross died

Nou mina oritorai,
He again rose

Nou ouato omiei,
He in heaven sits

No nimogido auri.
to for us. look

4. Nimo aue uaratai
We greatly ask

Nouna Oboro Zugu,
His Spirit holy

Nimogido uarabai,
us help

Iuio rorodia.
days all.

10. Iesu na Nirimogari
Jesus's love.

1. Satauro! Satauro!
Cross Cross

Nimo dogo eso,
We still thank

Iesu ovato oriai,
upon (it) died

No kigiro uosa.
to life give.

2. Gaire tonar barkak

Iesu natomertare:

E meribi nakuare

Abara jauali.

3. E emetu eumida:

E edede akaida:

E emri kotore ge,

Ko meribi dasmere.

4. Meriba abi damos

Abara Lamar Zogo:

Meribi upinati

Gaire geregere.

22. Satauro Dikiapor.

1. Satauro! Satauro!

Meriba esoao,

Iesu emetu eumida

Mi edede nakuar.

2. Au nirimogari
Great pity
Iesu nimogido;
for us
Iesu ouato omiei,
in heaven sits
No nimo uarabai.
to us help.

3. Iesu pai diriuo
not wish
Nimo no oriai;
us to die
Nou nimo nirimogari,
He us loves
Nimo rorodia.
us all.

4. Nimo eberiai
We cast away
Aue uba tanar,
many bad actions
No Iesu geso Buraigo,
to good chief
Auri kauitato.
follow right.

5. Iesu geso Masta,
good Master
Nimo atamuai
us teach
Roro diriuo auogati,
Thy wish do
Sirio sai mabu
all days.

2. Iesu mi omare
Iesu mi aseser
Iesu kotor ge emeri
E meribi dasmer

3. Iesu nole la kak
Meriba eumida
E gaire le au omare
Le giz uridili.

4. Mi naba ademe
Gaire adud tonar
Ko Iesu debe Opole
Irmili barkakem.

5. Iesu debe Kole
Ki ereuereme
Mara lagelag ikëli
Gair gereger.

XIII.—Daudai and English Vocabulary.

This Vocabulary, of some 2000 words, is compiled chiefly from the ms. Vocabulary of Rev. E. B. Savage (ms. 7), the Mowat Vocabularies of Haddon (ms. 2), and Mr. E. Beardmore (ms. 1), and has been greatly extended by the Kiwai Vocabulary of Sir William MacGregor (Nos. 22 and 23). Words have also been added from the texts (Nos. 19, 20), and from D'Albertis (No. 9). m indicates the Mowat dialect; mb, the Mowat of Beardmore; p, Perem; k, Kiwai of Mac Gregor; ks, the Kiwai of Rev. E. B. Savage; f, mouth of the Fly River, from some ms. notes by the Rev. James Chalmers, relating to some ethnographical specimens, many of which are in the British Museum; the figures in brackets refer to the illustrations of these objects in Ethnographical Album of the Pacific Islands, by Edge Partington and Heape (vol. ii.). A few words have also been added from Domori Islands in the Fly Estuary.

abara (m), *n.* to-day.
abara, abra, *ad.* now.
abarkai, *v.* to come. Mir. tabarki.
abea (m), *n.* a woven bag, like a net.
abera, *n.* father. Cf. baba.
aberaburŭ (k), *n.* aunt.
aberuti (k), *v.* to boil; obo aberuti, *v.* water boils. Cf. bibiriti.
aberuti (k), *v.* to leak.
abidiro, abidiru (k), *v.* to paddle. Cf. aibi.
abidiru dubu (k), *n.* oarsmen.
abo (k), *n.* house posts.
abodo (k), *n.* a song. Cf. wasare, poho.
aborïora (mb), to micturate.
aborohi, *n.* good spirits who inhabit the Megapodius mounds. They come to men in their sleep, and tell them where to find dugong, turtle, and fish, and where to make fruitful gardens. Ann. Rep. 1894, p. 58.
abraduo (k), *n.* to-night.
abrăsai (k), *n.* to-day. Cf. doguaimi.
adabuai, *v.* to marry; *a.* married.

adabuti, *v.* to meet in one place, to add, to spell, to place one upon the other.

adagauri, *v.* to step over.

ădiga (M), adigo, *n.* an armlet of rattan worn to defend the left arm from the bowstring.

adimo, *n.* evening; afternoon. Cf. erasugumai.

adina (M), *a.* good.

adina-pua (M), *a.* not good, bad.

adiowera, adiowara (M), *n.* good talk. Cf. adina, wera.

adipirudureru (K), *a.* bright.

adiriti, *v.* to smear, to anoint.

ado (K), *n.* a cap.

ado, *v.* to allow.

adorowa (K) = adoruti.

adoruti (K), *v.* to thatch (?); weri adoruti, weri adorowa, *v.* to make a roof.

aga, *n.* an anchor.

agaba (?) agaba tĕriko (M), *v.* to cut with a tomahawk; agaba giri (M), *v.* to cut with a knife.

agadioti (KS), *v.* to stir up.

agamu (M), *n.* the cheek. Cf. ogomu.

agareba (M), *n.* a fern used as food.

agasipi (K), *n.* a turban.

agati (K), *v.* to wave, of feathers.

agiriti, *v.* to haul.

agiwai, *v.* to give. Cf. ua, uosa, nimoria, noosa.

agoago (K), *n.* a yellow dye. Cf. sowora, madira.

agoita (M), *v.* get out of the way.

agoitago (M), *n.* walking.

aguitogu = Mir. kei bakeam.

agumanakai (F), *n.* a charm stuck in a canoe when going turtle or dugong fishing (pl. 203).

agurabai (?)

agurabuti (K), *v.* to pluck; pasa agurabuti (K), *v.* to pluck feathers from a bird.

agurubai (K), *v.* to dig.

ahima, *v.* to go in a boat, to pass over the sea. Mir. atiem.

ahera, *n.* a centipede.

ahauma, *v.* to arise.

ai (K), *v.* to go.

aibi (M), *n.* a paddle oar; abidiro (K), aibidira (M), *v.* to paddle; abidiru dubu, *n.* oarsmen.

aida (P), *n.* mother. Cf. mau, ida. (Also given as K by Mac Gregor.)

aidimuti, *v.* to choke.

aidomai. *v.* to cover (sing.).

aiĕna (M), *n.* a species of snake (Saib. elma), the same as bigu.

aimagoiti, *conj.* then, so that.

aiodori (K), *v.* tide goes down the river.

aipura (K), *n.* a handle. Cf. dudu, dudupo.

aira (M), *n.* the lower limbs.

airerea, *v.* to have, get, possess. Mir. nagri. Cf. iriuia.

airimaheruo, *a.* bright, shining. (Mir. zorom). Cf. airimerua.

airimerigodoi (K), *v.* tide goes out.

airimerua, *n.* lightning.

airimetaruti, *v.* to look round. Mir. ĕgĕli.

airioridoro (K). *v.* to rise, of the sun. Cf. oritorai.

airo, *n.* the foot; airona, stocking (?), Mir. teter wali; airo gabo, sole of foot, shoe. Cf. sairo.

airodori (?)

airogabo, *n.* sole of foot, shoe.

airogo, airogu, *v.* to walk, to walk about.

airoriro (K), *v.* tide comes in.

airororo = Saibai, gurgui uzar, Mir. digemili (KS). The meaning is not given (probably means going round about. Cf. airoriro).

airorosoriauti (K), *n.* ache.

airupata (M), *n.* the feet. Cf. airo.

aiwadi (?) misprint for amadi. In (KS) given as equivalent to Mir. sererge.

amadi, *v.* to rejoice. Mir. sererge.

amaditi, *v.* to bind round.

amahaudia, *v.* to go down.

amahiri, amairi, *v.* to squeeze, press together, connect, join.

amamurika, *v.* to fight.

amario, *v.* to fast, go without food.

amawitu (K), *n.* a venomous snake.

ame (?), *n.* a kind of dye.

amedei (K). *a.* inland, to the bush.
ameduti (K), *v.* to twist, of a snake. Cf. garamaduti, amaditi.
ameopuro (M), *n.* a gourd for carrying lime.
amesosogoro (F), *n.* a charm, shaped like a sausage, fastened to the holes in the rim of the ear of lads when initiated, made of young frond of sago palm, and dyed with ame (pl. 193, 4).
amiaupu, *n.* a bottle (? water skin.)
amiditi (K), auera amiditi, *n.* a rumour.
ami-igerai (M), *v.* to haul taut.
amiopuru (K), *n.* a lime gourd, = ameopuro (M).
amo (M), *n.* the breasts; milk, (K).
amoiopo (M), *n.* the mammæ. Cf. amo, iopu.
amoisi (K), *v.* to suck, of a child at the breast. Cf. amo.
amu (M), = amo.
amura (K), *n.* the bird of Paradise, *Paradisea Raggiana.*
amutia *v.* to put out the hand or foot. Mir. itir.
ănega (M), *n.* *Calladium esculentum;* taro.
apararubi *n.* a guest, a stranger. Mir. sub le.
aparatara, *n.* an ant.
apate (M), *n.* = epate.
aperarubi (K) = apararubi.
apisau (K), *n.* a spider. Cf. gaira.
aporu (M) = epuru.
apuo, *prep.* beyond, on the other side of, Mir. apek; *n.* a part, remainder. Mir. kaier.
aputi = Mir. atatko, Saib. malan (KS).
ăra (M), *n.* a fence.
araberŭmo *v.* to fight, to strike. Cf. korodia.
aradimai, *v.* to cover over (*plur.*). Cf. asidimai.
aradiri (M), *n.* red earth.
aragiria (M), *v.* fight him.
arago, *v.* to speak.
aragotai, aragoto, *v.* to carry on the shoulders.
araia (M), *n.* heat, sweating. Cf. era, eraia.
araigiri, *v.* to be born, to go out. (Mir. osmelu). Cf. erhaigiri.
aramiditi *v.* to keep one waiting when another has sent him. (Mir. bamesili, Saib. nurai).
aramorubi (K), *n.* God, apparently from aromo, sky, and arubi, mankind. Cf. oradubu.

arapoi, *v.* to show.
arapori, araporia, *v.* to differ, to divide.
araporio, *n.* time near sunrise. Mir. gereger osakeida.
ararabia, araribia, *v.* to cast out, to thrust out.
ararupo, *v.* to burst. Mir. arperik.
aratabuti (K), *a.* all.
arategere (K), *v.* to carry under the arm.
aratiaiado, *v.* to taste. Mir. tepdesker.
aratoro, *v.* to ask [aratorodi, aratorodoi].
arawai, *v.* to clothe. Mir. ami. Saib. angai.
ari (M), *v.* to sing.
ariaga (M), *n.* a fishing line.
aribamo (K), *n.* a species of banana.
arigiti (K), *v.* to scratch, shave.
arigoita (M), *v.* to get out of the way.
arima, *n.* blood; arima ne, dysentery.
arimina (PM), *n.* a fish. Given as K also by MacGregor. Cf. irisena.
aro (M), *n.* a large rattan cane.
arogo. *v.* to speak; to ask, bid (K); *n.* a message (K).
arogoto, *v.* to go.
aroguti, *v.* to speak. Cf. arogo.
aromi (?)
aromo (M). *n.* heaven, the sky. Said to be inhabited by white people with white hair and beards.
aromorubi (K), *n.* the inhabitants of aromo; *n.* earthquake. Cf. momorua.
aru, *v.* to sow (*sing.*). Cf. iboriti.
arua, *a.* some. Mir. uader, Saib. durai.
arua (M), *n.* a species of snake (Saib. tabu); erawa arua (M); *n.* a poisonous snake.
arubi, *n.* mankind (M); many men (KS); an assembly (K). (Mir. gaire le.) Cf. dauari, auarubi.
arubia, *v.* to fly. Cf. uarubia.
arumo, *n.* the penis.
arumo (K), *n.* a heavy thunder shower.
aruo, *n.* neck. (Given in Savage's Voc. as equivalent of Mir. tabo.)
asidimai (K), *v.* to cover. Cf. aradimai.
asio (K), *v.* to cut with a knife. Cf. itouti.

asio, *v.* to sneeze.

asioro (K), *v.* to bale; obo asioro, to bale out water.

asisopu (K), *n.* the armpit; asisopu-muso, the hair of the armpit.

asumo (K), *n.* a variety of sweet potato; keakea asumo, a white variety; dogodogo asumo, a red variety.

ăta, *a.* another, other.

atamuai, *v.* to teach.

atamudiro (K), *v.* to interpret, translate.

atapia (M), *n.* paper.

atari (K), *n.* the lobe of the ear, (when long and torn). Cf. usia.

atatiai, *v.* to detest, hate, be disgusted with.

atauti, *v.* to make.

ateria, *v.* to out-run, to pass by.

atima (Domori), *n.* cap used by Obere, bush tribe, in dancing and fighting (pl. 191, 3); atima-ata, net worn by Obere on head when in mourning for parents or wife (pl. 191, 2).

ătio (M), *n.* a fern.

ato, *suffix*, in, at, on.

atŭmiai (K), *v.* to fill up.

atumiai, *v.* to catch fish.

aturupo (K) (F), *n.* the bowl for the waduru or pipe (pl. 188, 1).

au (?), au-tuburo (M), *n.* the stomach.

auagati, *v.* to do, make. Cf. wogati.

auaguama, *v.* to speak ill of. (Mir. desauersili. Saib. gegedöpugan.)

auana (P), *n.* a man. Cf. didiri, arubi, dauari.

auarubi (P), *n.* many men. Mir. gaire le. The Mir. le giz is translated by the Daudai dauari.

auaruo, *v.* to sew.

aue, *a.* tight, fast, firm.

aue, *a.* plentiful, numerous.

auera (K), *n.* speech, language; auera amiditi, *n.* rumour. Cf. ouera.

augaruharuru, *v.* to follow. Cf. ougi.

auia, *a.* bigger. Cf. Mir. kale.

aumaro (K), *n.* a species of banana.

auo, *a.* large, great, big; auo obo, *n.* deep water. Cf. oromoito; auo pe, *n.* a ship.

auo durupi dubu (K), *a.* corpulent, lit. big body man. Cf. Motu, nuana bada, corpulent, lit. his belly big.

auoauo, *a.* very large.

auodoi, *v.* to spill.
auoduti, *v.* to spill.
auogu (K), *v.* to bring.
auomaro (K), *n.* a species of banana.
auoto, *v.* to plait.
aurai, auri, *v.* to put forth.
auti (?) otăauti (K), *v.* to divide.
autoogu (K), *v.* to go away.
autuburo (M), *n.* the stomach (D'Albertis). Cf. auo, tuburo.
awadau, *n.* a species of banana.
awado (?) tepetepe terisi awado (K), *v.* to flog.
awaia (K), *n.* a pelican.
awo (K), a jelly fish.
awogu (M), *v.* come here. Cf. ogu.
awua (M), *n.* plenty. Cf. aue, auo.
awugo (F), *n.* belt worn by young men.

Baba, *n.* father (in vocative only). Cf. abera.
baga = bago; bagamuo (M), *n.* the beard.
bage (K), *n.* white shells (?). Cf. bata.
bagi (M), *n.* a belt worn in a dance; a girdle (K).
bago (M), *n.* the chin; bagamuo, *n.* the beard.
bagoro (K), *n.* a variety of sweet potato.
bagu (M), = bago.
baika, baiko (K), *n.* a trade bag, a sack; auo baiko, large sack; sobo baiko, small sack. (Probably introduced from Eng. bag.)
băna (M), *n.* a partner (in dance).
bane inatoroa. Mir. be iwaokai, streaks of light at sunrise. Cf. Mir. be, iwaokai.
bani, *n.* the faint light before daybreak.
bano (K), *n.* a long, thin centipede.
bara, *n.* a sheet of metal. Cf. malili, mariri.
barahoro (M), *n.* the ribs. Cf. barasoro.
barako (K), *n.* a variety of yam.
baranedo (K), *n.* a variety of banana.
barasoro (K), *n.* the ribs. Cf. barahoro.
bari, *n.* the end (K), *n.* blade; point of a palm frond; bari-ato, at the last, until.

baribari, *a.* young, of a coconut.

baroma (K), *n.* a pig.

basabasa (K), *n.* a net for fish.

bata, *n.* a girdle, belt; a long band used for carrying firewood; cuirass of cane. (Mir. wak.); bage bata (K), a leather belt; poto bata (K), a belt with white shells. Cf. bagi.

bata (K), *a.* thick.

batamere, (F), *n.* a frontlet.

be,

bedaiuio ? *an interrogative particle.* Mir. na ?

bedamota ? bedamutu (K), *ad.* how many ? Mir. naket ?

bedana (K), *pron.* which one.

bedar ? *pron. interrog.* what ? Mir. nako. Cf. bertu.

begube (F), jew's harp. Cf. pekupe.

benupedudi, *v.* to think, believe. Mir. odaratare.

benumuguruti, *v.* to repent. Mir. obazgeda.

beo (M), the liver.

ber, *n.* a boar's tusk.

bereburo (M), *n.* a girl.

berego (K), *n.* a variety of banana.

beromamu (F), *n.* a kind of arrow.

berseai (K), *v.* to throw away; leave off! Cf. isiro.

bertu (M), *pron.* what ?

besĕre, beseri (KS), *n.* a girl, an unmarried woman; daughter (K). Cf. bueri.

besi, *a.* slow, difficult, moist, heavy (of the eyes). Mir. beber, wapum.

beturo (K), *pron. interrog.* who ? Cf. botur.

beu (K), *n.* the liver; imuru beu (K), *n.* the spleen.

bibiriti (K), *v.* to boil (active); iro bibiriti, to boil food.

bidibidi (K), *n.* a pendant of shell worn from the neck. ? dibidibi.

bidu (K), *n.* a shark. Cf. biju.

bigi (M), *n.* the coccyx; the loins (K); the back (Beardmore).

bigu (M), *n.* a species of snake, so called by the bush men. (Saib. elma.)

biju (M), *n.* a porpoise. Cf. bidu.

bio (F), *n.* post of house on which trophy-skulls are suspended.

biroro (M), *n.* scolding, (D'Albertis). Cf. wiroro.

boa (K). *n.* a variety of yam.

bobo, *n.* a lagoon, a pool; a bog, swamp (K); an excavation, well, water hole (K); obo-bobo (K), a lagoon.

boboku (F), a kind of arrow.

bobua (? bobo), edea bobua (K), *n.* a grave.

bodoro, *n.* the breast; the chest, bosom.

bodoro, *v.* (? to hunt or persecute) in Savage's MS. as equivalent of Saibai wakaean, Miriam deskemer. Plur. bodorodi = Mir. deskemereda.

boia (K), *n.* a variety of banana.

boigaro (?)

bomakiwa (F), *n.* boar's tusk worn as a pendant from neck. Cf. boromo.

bome (F), *n.* a headdress worn in fight and dance.

boŏ (M), *v.* to fight. Cf. boso.

borguborgu (K), *n.* baggage = burgoburgo; borguborgu sirio (K), *n.* wealth or property (plenty of baggage).

boro, *ad. interrog.* where?

boroboro, *a.* rotten.

boromapoa, *n.* a dance held before a pig hunt. Cf. boromo.

boromo (K), *n.* a variety of banana.

boromo (M), = baroma, buruma.

boso (K), *v.* to fight; *n.* war; boso didiri, *n.* a warrior; wasare boso, *n.* or *v.* whistle. Cf. boo.

botama (M), *n.* cloth; kari botama, *n.* white cloth.

botuna, *pron. interrog.* whose?

botur, *pron. interrog.* who?

bramgerămā, bramgerima (M), *n.* sister.

buama (K), *n.* the cowry shell. *Ovulum.*

buaraigo, *n.* a chief. Mir. opole, tarim le. Cf. mamoosi.

bubu (K), *n.* a fog.

bubuama (K), *n.* a variety of banana.

bubuere (K), *n.* a cloud.

bubugiro (K), *n.* a variety of banana.

budano (K), *n.* a variety of yam.

buere (P), *n.* a girl, an unmarried woman. Cf. besĕri.

buĕrmĕri (P), buere-mĕre (M), *n.* a little girl. Cf. buere, mĕre.

bugomu (K), *n.* a cicatrix. Cf. nato.

buku (K), *n.* an owl.

bumese (K), *n.* a white lily.

burgoburgo (K), *n.* baggage.
burkŏma (K), *n.* whitebait; burkŏma orobai, *v.* to catch whitebait.
buroburo (F), *n.* the cylindrical drum with annular ends (pl. 189, 6).
buru (K), *v.* to break.
buru, *a.* empty; obo-buru, empty of water.
buru, *n.* the outside; buru-mouro, the outside of a place.
buruma (M), *n.* a pig.
buruma (K), *n.* a variety of yam.
burumamaramu (F), a bull-roarer: when used all women and children leave the village and go into the bush. The old men swing it and show it to the young men when the yams are ready for digging (May and June). The name evidently signifies "the mother of yams" (pl. 201, 2).
bururu (Domori), *n.* a headdress used in dancing and fighting.
busere (K), *n.* a girl; busera (F), a young girl.
butauogu (K), *v.* where are you going?

dadara (?), dadara dubu (K), *n.* a fool. Cf. karatai duba.
dadu (K), *n.* a bunch of grass tied on a pole and stuck up on a canoe, hence, a flag.
dagoi (M), *n.* a head-dress made of cassowary feathers worn in dances.
daguri (K) (F), *n.* a head-dress of black feathers. Cf. dagoi.
damari, *n.* the eyes (Mir. pone); the eyeball (K); damari muo (M), *n.* eyelash or eyebrow; damari tama, eyelid (K); damari gede (K), *n.* ophthalmia.
damari, *v.* to shut the eyes, to consider. (Mir. erkepasam.)
damarupere, *a.* blind. Mir. sadmer.
damedame (K), to swim.
damo (K) (?), oromo damo, *n.* the ocean. Cf. oromo.
dapŭrkup (M), *n.* a necklace.
daradari, *a.* foolish.
darapi (?).
darimo (M), *n.* a house for men.
dau (M), sago.
dauari, *n.* men. (Mir. le giz.) Cf. auarubi, arubi.
daunomu (K), a stone axe.
dawane (K), *n.* the summit.

debiridaguri (Domori), *n.* short head-dress worn in dancing and fighting (pl. 191, 4).

dewara (K), *n.* the yaws.

di (K), *n.* a pig net.

dibadiba, *n.* a dove.

dibi, *a.* full. Mir. osmeda.

dibidibi (M), *n.* the round shell ornament.

dibiriduba (K), *n.* the east.

didididi, *a.* fast, quick; *v.* to be quick.

didiri (KS), *n.* man, mankind; men (K). Cf. auana, dauari, arubi.

diridiri (K), *a.* brown; *n.* a variety of sweet potato.

dirimo (K), *n.* the ground.

dirimoro, *n.* land, country.

dirioro (K), *a.* venomous, of snake; *n.* a venomous snake.

diriuo, *v.* to desire, to wish; diriuo-tato, pai diriuo, *a.* unwilling.

diro.

diruo (K), *n.* or *v.* purpose.

diware (K), = diwari.

diwari (M), *n.* the cassowary.

diwari (F), *n.* dagger made of leg bone of cassowary, also used for opening coconuts (pl. 193, 2).

doa, *v.* to murmur (Mir. wekuge); don't want to go (M).

dobari (M), = dubari.

dobi (M), = idobi.

doburu (M), *n.* the pelican. Cf. awaia.

dodiai, *v.* to save, to heal.

dodo, *n.* a bed.

dodo, *n.* the shore, beach, coast, land. Cf. dodoro, tuturuo.

dodobu (K), *n.* a fathom.

dododenamati (M), *v.* to forget.

dodogonimati (K), *v.* to forget.

dodonamatigi, *v.* to forget. Mir. okataprik.

dodoro (K), *n.* the coast. Cf. dodo, tuturuo.

dogo, *n.* a torch, flame, lamp. Mir. be. Saib. buia.

dogo, *ad.* yet, still, by and by, continuously (Mir. mena); *v. imperative,* hold on! wait a bit. (Mir. warem.)

dogoaimi (K), *ad.* by-and-by.

dogobe (K), *a.* round; dogobe sagana (K), *n.* full moon.

dogodogo (K), *a.* red; dogodogo asumo, *n.* a red sweet potato.

doguaimi (K), *n.* to-day.

dokatota (K), *v.* to hack, said of the sago palm.

dokitotiti (K), *n.* the fireplace frame in a house.

dopi, *n.* the stomach. Mir. kem.

dori (F), *n.* a headdress worn in the dance only.

dorogra, *a.* false.

doto (K), *n.* the hip.

dou (K), *n* sago; dou iopu, a cone of sago; dou tarame, *n.* sago in a small roll; isi dou (M), *n.* cooked sago. Cf. siahu. "Sago is prepared by the women; it is put up in small rolls about two inches in diameter, called 'dou tarame,' and in large bundles about one foot or nine inches in diameter, and about three feet in length, wrapped round in leaves, and stiffened by the midrib of sago leaves tied on to it. These bundles are called 'dou siahu.' It is eaten roasted in leaves or on the coals, or made into a pie with clams in the shell."—Mac Gregor, Report, 1890, p. 40.

două (K), *v.* to kill (a mosquito).

dri (M), *n.* a white feather head-dress.

driomoro (M), *n.* earth, soil. Cf. dirimoro.

dua.

duatata, *ad.* the third day since, the third day hence.

dubari (M), *n.* banana.

dubi (M), *n.* the upper part of a water spout.

duboro (K), *n.* pandanus; duboro pasa, *n.* pandanus leaf; tiro, *n.* mat made from pandanus.

dubu, *a.* male; *n.* a husband; man (M).

dudi (K), *n.* the mainland on the right bank of the Fly River.

dudu (K), *n.* a handle; a fanshaped tomahawk. Cf. dudupo, aipura.

dudu (K), *n.* a reed.

dudu (K), *n.* a variety of banana.

duduaere (K), *n.* the morning.

duduaereta (K), *n.* the fore-noon.

duduata (K), *n.* yesterday; duduata sai (K), *n.* yesterday.

duduere, *ad.* in the morning.

duduŏ, *ad.* yesterday, to-morrow; duduŏ sai (K), *ad.* to-morrow.

dudupo (K), *n.* a handle, Cf. dudu, aipura.

dumehe, *n.* a row of men, a generation. Mir. nosik.

dunini (K), (?), in MacGregor's voc. given for 'squirrel,' but there are no squirrels in Kiwai.

duo, *n.* night, *ad.* in the night. (D'Albertis gives duo, day.)

duomuto, duomutu, *n.* to-day (M); *ad.* the day after to-morrow, the day before yesterday; after.

duotau (M), *n.* yesterday;

dupamutu (F), *n.* a kind of arrow.

dupu (M), *n.* elephantiasis.

durugere, *v.* to be hungry; *n.* hunger; obo durugere, *a.* thirsty.

durugi (K), *v.* to dine.

durugi, *n.* darkness; *a.* dark.

durugidurugi, *a.* dark.

durupi, *n.* the body; trunk or stem of a tree; durupi-nibo, *n.* a perfume, lit. body scent. (The Mir. geme-lag has the same meaning); uibo durupi (K) an albino; durupi tato (K), *a.* feeble (no body).

durupiwoa (M), *a.* lazy.

E, *conj.* also, and. Mir. pako.

ea (K), *n.* a spade.

eamo (K), *v.* to squeak, of birds.

ĕbĕriai, *ad.* away; *v.* to put away.

eberiti, *v.* to cast away, to throw away.

ebeta, *pron. interrog.* what? what thing? Mir. nalu.

ebia, *v.* to break.

ebiari, *v.* to be unable. Mir. nab. Saib. ian.

ebiba (M), *n.* stone. Cf. nora.

ebitagido, *ad. interrog.* how? why? lit. for what thing. Cf. ebeta, gido.

ebonupoe (K), *n.* the heel.

edamari = damari, idamari; edamari muso (K). eyebrow.

ede (K), *n.* a snake; kiso ede, *n.* a snake said to be poisonous.

edea, *v.* to put, to place, to put down; to bury (K); edea bobua (K), *n.* a grave.

ediai (M), *v.* to come up from below.

ege, *n.* (? the outside); ege auana, *n.* heathen. Mir. nog le. Cf. buru.

egediuti (P), *v.* to stir up. Cf. agadioti.
egethia (K), *v.* to put the burning tobacco into the mouth to blow smoke into the waduru.
eka (K), *n.* lime; white paint; eka iriso, *v.* to eat lime.
eke (K), *a.* little.
ekeburi (K), *a.* little, young; *n.* a remnant; ekebure obo, *n.* shallow water.
ekeburiekeburi, *a.* very little.
emaaiiopu (K), *n.* stone axe.
emadi, *v.* to buy.
emado (M), *n.* the leg; emadu-kako (M), *n.* the tibia.
emapura (K), *n.* son-in-law.
emaserue (K), lightning. (? lightening in MacGregor's list.)
ĕmera, *v.* to leave, put aside.
emeragidiro, *v.* to think. Cf. meragidiro.
emerewis, *v.* to scorch.
emereuti, *v.* to lighten, to light up.
ĕmĕriai, *v.* to send; to give up; leave M.
emeriuidiro, *v.* to lighten, light up.
emetiodoi, *v.* to speak, to pour out words, to command. (Mir. mer. tigri.)
ĕmeuti, *v.* to make straight, to adjust, judge.
emherai, *v.* to stop any one from fighting. Mir. daismuda. Saib. guduadan.
emiserai, *v.* to comfort, console.
emoa (M), *n.* a stone hatchet.
emoaiopu (F), *n.* the stone of the old stone axe, now placed round graves, "but it is not now known what they were used for in the long ago." (pl. 198, 2.) Cf. emoa, iopu, emaiiopu.
emoputi, *v.* to count. Cf. oputi.
emososiriti (K), *v.* to tie a man by the hands.
enadi (K), *v.* to shake hands.
eneauri (K), *v.* to see. Cf. idamari.
eneene (K), *n.* a small brown ant.
epate (M), *n.* the outer ear. (Mir. laip.) Cf. sepate.
epe (M), *v.* a fern.
epeduai (K), *v.* to throw, to throw the tete. Cf. berseai, isiro.
epi (?)

epidabia (K), *n.* the ring finger.
episuromoroă (K), *n.* a door.
epoo (K), *v.* to plant. Cf. ibăuti.
epora (M), *n.* enclosures of wood.
epuko (M), *n.* the head.
epurkod, *n.* a hat. Mir. aper.
epuro (M), = epuru; epuro-muo, *n.* hair (of head).
epuru, *n.* the head; skull; epuru muso (K), *n.* hair (of head); epuru temeteme, *n.* headache; epuru ivi (F), *n.* frontlets worn by old men.
epuruo, *v.* to take away, to hide.
era, *n.* fire; light (K); era ota, fire wood; era itai (K), *v.* to roast. era eragido itai (K), *v.* to warm.
era (K), *n.* a snake, said to be poisonous.
era, hera (P), *n.* breath; eratato, *a.* without breathing, continuous. Cf. sera, seratato.
erabai (P), *v.* to grasp, catch. Cf. orobai. (Mir. erpei.)
ĕraĕra, *n.* heat, sweat; *a.* hot.
eragumito, *v.* to burn. Cf. era, fire, and suffix ito.
eraia (M), *v.* to roast.
eranapar, *v.* to take breath, to rest. (Mir. nerezi.) Cf. era.
erape uibu (K), *n.* coal, lit. steam ship charcoal. Cf. era, pe, uibu.
erapo, *a.* strong, well. Mir. saserim.
erapotato (K), *a.* strong.
erasugumai (K), *n.* evening, sunset. Cf. adimo.
eratato, *a.* continuous, lit. without breathing. Mir. nerkak.
erau, *n.* anger.
erauidiro (KS), *v.* to hear. Cf. mitidiro.
erawa (M), *a.* poisonous (? fierce); erawa arua, *n.* poisonous snake. Cf. erau.
erawabu (K), *n.* a venomous snake.
erawo (K), *n.* a variety of yam.
ereberiai, *v.* to rise, as the sun; *n.* sunrise. Mir. gereger eupumada.
eregedioti (K), *v.* to hang.
eregeduti, *v.* to fall.
eregetei (K), *ad.* downwards.
eregeti, *v.* to lose, to fall. [eregetidi.]
eregetuti, *v.* to destroy. Mir. eogerdi.

erehia (M), *a.* tired.
eremětěrai, *v.* to turn round.
ereno, *inter.* an exclamation of wonder or surprise. Mir. waiai.
eresa (K), *n.* a border or edge.
eresapua (K), *n.* half. Cf. sapua.
ereta (?)
erhaigiri, *v.* to go out, to be born.
erigedio (P), *n.* work. Cf. kerigedio.
erudomoti, *v.* to pray.
esee (K), *n.* an edible snake, said not to bite.
esirigo (K), *n.* the calf of the leg.
eso, *v.* to thank.
esume (K), *n.* an artery or vein; skin.
etaauito, *v.* to glance.
ete (K), *n.* the little finger.
etebeai (K), *v.* to double; to catch (M).
etebuti, *v.* to roll up.
eteturi (M), *n.* the ring finger.
euri (P), *v.* to see. Cf. damari.

Ga (K), *n.* a cockatoo.
gabagaba, *n.* a stone club.
gabigabi (K), *n.* a straw cross belt worn in dances. Cf. genaio.
gabo, *n.* a path or road; sole or shoe; (airo gabo = Mir. teter gab) a gate (K); doorway (M).
gabu, *v.* to warm one's self.
gabu, *n.* cold. (Mir. ziru.)
gabugabu, *a.* cold.
gadi (K), *n.* fat, flesh. Cf. sirigo.
gagama (K), *n.* the spoonbill.
gagari, *n.* bow; bow and arrows; 'trigger' gagari, a gun; a bamboo (K). "The bow is made of a piece ef bamboo, nearly an inch thick, about two inches broad in the middle and tapering to the ends. The inner surface is on the convex side."—Ann. Rep. 1890.
gagi (M), *n.* an ear-ring.
gagimere (F), *n.* an ear-ring worn by all.
gaime (K), *a.* distant, far, far away. Cf. gĭătoŭ, mureso.

gaira (K), *n.* a spider. Cf. apisau.

gama, *n.* a cylindrical drum with jaws at one end; tĕriko-gama (M), *n.* a piano or other European musical instrument (Beardmore).

gamada siea (K), *n.* *Piper methysticum.*

gamăsa, *a.* bad.

gamo, *n.* the turtle; gamo soro, turtle shell. Cf. tumanua.

gamosusu (K), *n.* a variety of sweet potato.

gāmū (M), *n.* a turtle.

gamuno (M), *n.* the moon (in D'Albertis).

ganoni (M), *n.* the moon; ganoni gerger (M), *n.* the moon (in Beardmore MSS.). Cf. gamuno, sagana.

garahia (?) apate garahia (M), *n.* the drum of the ear. Cf. epate, gare, ia.

ganopa (K), *n.* a cavity.

ganumi, *n.* the moon; ganumi mere, *n.* white people.

garagaro (F), *n.* a kind of arrow.

garamaduti (K), *v.* to twist, of twine. Cf. ameduti, amaditi.

garaoro (F), *n.* loop on which an enemy's head is suspended.

gare (K), *n.* the external ear. Cf. sepate, epate.

garetato (K), *a.* deaf, lit. without ears.

garigari, *ad.* in vain. Mir. sagim.

garigari (K), *v.* to loiter; garigari dubu, *n.* a loiterer.

garo (K), *n.* a baler, made of the spathe of the leaf of the coconut palm.

gărŏroă (K), *n.* a snore.

gato (K), *n.* mud; gato titi, *v.* to smear or paint with mud in mourning. Cf. Saibai bud.

gatotiti (K), *v.* to smear or paint with mud.

gauă (K), *n.* a creek. Cf. oromo turi, gou.

gaumabu (K), *n.* an armlet made of wedgewood ware.

gaut, *suffix*, from.

gebo, *ad.* sign of quotation, thus, saying thus; Mir. kega. Saib. keda.

geborara (K), *v.* to speak, to say.

geboso (K), *n.* a noise.

gĕdagebi, *n.* proverbs. (Mir. babisdari mer); *a.* like, the same way. (Mir. mokakalam.)

gede (?)

gedogibo (K), *ad.* all the same. Cf. gĕdagebi.

gege (K), *n.* a crescent-shaped breast ornament; nese gege, a breast ornament of pearl shell.
gemaiopo (M), *n.* an extraordinary swelling of the glands of the groin.
gĕmĕde, *v.* to rail at, to abuse.
gemedi, *n.* adultery.
genaio (M), *n.* a necklace or crossbelt of dogs' teeth; (F) ornament of dog and wallaby teeth worn by men and women when they fight or dance.
geradu (K), *v.* to spit.
geraduru (K), *n.* saliva.
gere (?)
gesere (K), *n.* a shrub "grown usually in the (? sweet) potato gardens, with leaves nearly like those of the ash, but smaller. Eaten as a vegetable."—Mac Gregor, Rep. 1890, p. 40.
geso, gesona, *a.* good.
gia (M), *n.* resin.
gĭătoŭ (K), *a.* distant. Cf. mureso, gaime.
gibo (K), *v.* to answer, reply. Cf. waratai.
gidinaro (K), *demonst. pron.* that.
gido, *suffix*, to, for.
gido (K), *a.* further; *ad.* there.
gigido (M), *n.* the spinal marrow.
gimai (K), *n.* a white pigeon.
gimini, *n.* the back; gimini-kako (M), *n.* the spinal column; gimini poa (K), *n.* the back; gimini soro (K), the backbone.
gimini (M), *n.* a sand bank.
giri, *n.* an iron knife.
giri (K), fingers. Cf. igiri, tuigiri.
giriopu (K), *n.* the sternum.
giromi (K), *n.* a variety of banana.
girop, *n.* the heart. Mir. nerkep.
giwari (K), *n.* poison.
gobodo (K), *n.* a variety of banana.
goboromi (K), *prep.* at.
godio (?)
gogonea (F), *n.* a large conical fish-trap made from spines of sago palm.
gogu (K), *v.* to go.
goi (?)

goina, *a.* this, that.

goinagaut, *conj.* because, for, through this.

goinoina, *a.* this, that.

goirĭ (K), *n.* an oyster.

goma (Domori), *n.* a drum.

gŏmasai (M), bad. Cf. gamasa, gŭmasa.

gomia (?) obo tao gomia (K), *n.* flood.

gomoa, *suffix*, along with, belonging to, with, alongside. (Mir. dog, Saib. bia.)

gonia (K), *n.* a fish-catcher, made of wicker work, "shaped like a candle extinguisher, about 18 inches in diameter at the lower end, and about 3 to 5 feet high. They chase the fish in shallow water, and place this implement over it, then press the sides together to secure the prey."—MacGregor, Rep. 1890, p. 40. Cf. gogonea.

gonimati.

gono drogu (M), *v.* are they, is he, is it coming here. Cf. ogu.

gonou, *ad.* far away. Mir. penoka, also given as equivalent of Mir. dali, he there.

gope (K), *n.* a shield*; (F), figure-head of a canoe, it gives a good passage (pl. 185, 3).

gopegope (F), *n.* an ellipsoidal slab of wood carved with designs of the human face or person, and hung on a new house for good luck.

gore (K), *n.* the betel nut.

gorogoro (K), *n.* a white duck.

goropo (M), *n.* a stone club, with star-shaped disc.

gorumo (K), *n.* a feather (from the breast of a bird). Cf. pasa.

gotaonaosa (K), *a.* each.

gou, goua, *n.* a river; *n.* a passage in a reef (M); goua bara (K), *n.* the bank of a river; pari goua (K), *n.* a drain or ditch.

gu, *n.* kinsman, friend, neighbour, probably one of the same clan or totem. Mir. boai. Saib. igalaig.

gubadora (K), *n.* or *a.* cold.

gubiri (K), *v.* to bury. Cf. edea.

gubo, *n.* a path. Cf. gabo.

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* "No shields are used about the Fly River, neither is the spear seen."—Chalmers MS. This word is probably introduced. Cf. South Cape, opea, shield.

gubu (K), *n.* a hammer.
gudigudi (M), *n.* a button, an auger.
gudogudo, *a.* thick.
guere (K), *n.* stingaree, sting ray.
gugi (K), *n.* a star.
gugi (K), *n.* a stone club with round disc.
gugu (F), *n.* head-dress worn in dancing and fighting (pl. 192, 2).
guguba (K), *n.* a plant "with large five-lobed leaves which are eaten cooked. We found this not unpalatable, the taste and feel being that of a plant belonging to or allied to Malvacea."—Mac Gregor, Report, 1890, p. 40.
gugurta (K), *n.* a species of lizard.
guitogu, *v.* to go. Cf. oguitogu.
gŭmasa, *a.* bad.
gumi (K), *a.* ripe.
gupuru (K), *n.* the navel. Cf. Mir. kopor.
guri (M), *n.* the forehead; the face.
guri (K), *n.* a shrub; guri sirigo, *n.* guri fibre.
gŭrŭru, *n.* thunder. The noise made by the Aromorubi cutting firewood.

Hări (M), *v.* to sing. Cf. wasare, poo.
harubi (M), *n.* = arubi..
hera, *n.* a breathing. Cf. sera.
heranapar, *v.* to rest, to take breath.
heratato, *a.* continuous (lit. not breathing).
hoihoi (M), *n.* a boy.
hollogo (M. D'Albertis), *n.* bird. Cf. wowogo, uoog.
hono (M), *n.* gall.
huhua (M), *n.* the wind. Cf. susua, uo.
huraaua (MB), *n.* a bag.

Ia, *an emphatic suffix to words; a.* true, real. Oradubuia, true God.
ia (KS), *n.* a fence.
iadohia, *v.* to speak. Mir. ditagi.
iano (F), *n.* a kind of arrow.
iapo (K), *v.* to bring. Cf. auogu.
iaprumu (M), *n.* a wig.

iaprupat (M), *n.* a comb.
iarabuti, *v.* to answer, to speak.
iare (K), *n.* an edible snake, said not to bite.
iaroguti, *v.* to preach. Mir. okadeskeda.
iarubo (K), *v.* to fly.
iauira, *v.* to sow.
iăwa (K), *n.* a tooth, teeth; baroma iăwa, *n.* a boar's tusk; iăwa temeteme, *n.* tooth-ache.
ibaba (K), *n.* a species of beetle.
ibăuti (K), *v.* to plant. Cf. epoo.
ibirorogomai (M), *n.* evening.
ibiu (M), *n.* the sun; ibiu-irogoro (M), *n.* morning.
ibonara (M), *n.* teeth.
iboriti, *v.* to sow (plur.). Cf. aru.
ibubu (K), *n.* a variety of banana.
ida (M), *n.* mother. Cf. aida.
ida baba (M), *n.* mother.
idamari (M), *n.* the eye; *v.* to see (K); idamari duduo (K), blind, lit. eye-dark.
idi (?), idi sirigo (K), *n.* a fibre, perhaps a kind of taga sirigo.
ididi (K), *v.* to build; moto ididi, to build a house.
idiidi (K), *a.* coloured, white and blue.
idobi, *n.* crying; *v.* to weep, cry.
idobisuo (K), *n.* tears. Cf. idobi.
idopi = idobi.
igiri (M), *n.* the nails (of fingers or toes); claw (K); middle finger (K).
ihehea, *v.* to pluck.
iio (K), *n.* a curlew.
ima (K), *n.* the ankle.
imadi, *v.* to carry, bear. Mir. tekau.
imadi (K), *v.* to rob. Cf. piro.
imairi (K), (*v.* to go?)
imarai, *pron.* thyself.
imo. In Ann. Rep., 1894, p. 59, *n.* sun. Perhaps a misprint for iwio, or ino.
imogorumo (K), *v.* to beckon to anyone to come. Cf. ragotogo.
imoria, *v.* to feed. Mir. desisi.
imoriatorimo, *v.* to feed. Mir. derasisi.

imorio, *v.* to give. Mir. aisuer.
imuru (?), imuru-beu (K), *n.* the spleen.
inaitato, *v.* to dislike. Mir. obogai.
ini-ipa, *n.* noon.
ino (KS), *n.* sun.
inoriro (K), *v.* tide goes up river.
io (K), *n.* the edge (of an axe); point of an arrow. Cf. eresa, bari, muba.
io, *ad.* yes.
iö (P), *a.* fast, quick. (Mir. wamen). Cf. siö.
iopu, *a.* ripe.
iopu, *n.* fruit, a seed; an egg; gamo iopu, turtle's egg; wowogo iopu, bird's egg; dou iopu, *n.* a cone of sago.
ioputi (K), *v.* to read.
ioritŏroi (K), *v.* to return.
ioro, *v.* to climb up, to ascend; to hoist up (M).
iŏto (K), *n.* an ulcer.
ipa (K), *n.* the clam; ipa soro, the clam shell, used as a knife, and also for making lime.
ipare (K), *n.* a native pie, made of clam and sago.
ipauipau (K), *a.* light green. Cf. sisiasisia.
iperiti, *v.* to snatch. Cf. uaigiri.
ipi, *n.* a piece, a part. Mir. mog.
ipipu, *a.* plentiful.
ipiriti (K), *n.* the face.
ipogi (K), *n.* a comb, also in Perem and Mowat.
iporigai, *n.* end; *v.* to finish; tau iporigai, to have finished. Cf. tau.
iporigaitato, *a.* without end, eternal.
ipu, *n.* the lips.
ipua (K), *n.* dirt. Cf. opu, sopu.
ipuaipua (K), *a.* dark blue.
ipuipu, *a.* dirty.
ipusu (K), *n.* the upper lip. Cf. ipu.
ipusuata (K), *n.* the lower lip.
ipuu (M), *n.* the whiskers.
iragido (?)
irako (F), *n.* a pillow.
irao (K), *n.* an insect.

irao (K), *n.* a variety of yam.
irao (F), *n.* a Kiwai pillow used by old men.
irara (?), irara-sukumai (K), *n.* the west. Cf. sie, sia.
iri? *v.* to shout, to call.
iri, *n.* the underside; iri-ato, *prep.* under, underneath. Mir. mud-ge.
iriato, *prep.* under.
iribu (K), *n.* a variety of banana.
iributi, *v.* to take knowledge of, to detect, find out. Mir. opasereret.
iridou (M), *n.* cooked sago. Cf. dou, irio.
irigiri (M), *n.* the foot. Cf. sairo, airo, igiri.
irimo (K), *n.* the name of a tree, the wood of which is used for canoes.
irio, *a* many. Cf. sirio.
irio, *v.* to eat, to bite. Cf. iriso, topo.
iriona (P), *n.* food.
iripuadoi (K), *v.* to burn.
irira (M), *a.* lost.
irisai wada (K), *n.* enemy.
irisina (KS), *n.* a fish. (MacGregor gives both irisina and arimina as "fish" in Kiwai); irisina tudi (K), *n.* a fish-hook.
irisino = irisina.
iriso (KS), *n.* food; *v.* to eat (K). Cf. iris, topo.
iritoedea (K), *v.* to put behind. Cf. iri, ato, edea.
iriuia, *v.* to have, get, possess. Mir. nagri. Cf. airerea.
iriveitorai (?), *n.* power, strength.
iriwoto (K), *v.* to hunt men.
iro = irio (K), iro bibiriti, *v.* to boil food.
irobouai (K), *v.* to jump.
iroidiro (K), *v.* to hear.
irorisiai (K), *v.* to die. Cf. uparu, utua, para.
iroruodiro (K), *v.* to drown.
irosorai (K), *v.* to crouch.
irŭmai (K), *v.* to call; *n.* signal (K). Cf. wiroro, koromai.
isio (?), isio karamatiai (K), *v.* to carry a child astride on the neck.
isiro (K), *v.* to throw away.
isisaia (K), *n.* a variety of banana.
isisira (K), *n.* plaited rope, string, cord, twine.
isisira (K), *a.* sour; thin.
isosirai (K), *v.* to fasten. Cf. mopo, emososiriti.

itai (M), *v.* to heat; era itai (K), *v.* to roast; eraera gido itai, to warm; "kettle" itai (M), *v.* boil the kettle.
itira (M), *n.* cord or twine.
ito (M), *n.* a basket.
ito-dubu (K), *a.* generous, liberal.
itouti (K), *a.* to cut with a knife. Cf. asio.
itoiriti, *v.* to bind.
iu, *v.* to run; iu uarario, *v.* to run along with.
iuea (M), *a.* inquisitive.
iui = iuio.
iuio, *n.* the sun; daylight (P); ipipu iuio, daily; iui ipa, noon. Cf. sai.
iuo (M), *salutation*, good-bye.
ivi (M), *n.* rope.
iwia (M), = iuio; iwia beriai. *n.* daylight, sunrise; iwia daugemi, sundown.
iwio, *n.* the sun; iwio-mere, *n.* all people who have yellow skin, e.g. Japanese, Manilla men.
iwiopoa (M), *n.* a sweet potato.
iyvauo (K), farewell.

Kabi, *n.* a tomahawk, axe; wari kabi (K), a stone axe.
kadami (K), *n.* a shrimp.
kadau, *a.* wild, not tame.
kadaudiro (KS). Given in Savage's MS. as the equivalent of Mir. marmar gem.
kadig (M), *n.* an armguard. Cf. adigo, kadigo (Domori).
kaegasi (F), *n.* charm worn by Osio, uninitiated lads, in dance.
kago, *n.* a branch.
kaiani (K), *n.* a rat; a masked dancer; a variety of banana.
kaiara (K), *n.* a species of beetle.
kairadubu (M), *n.* a brother.
kakaba (K), *n.* a fowl.
kakau (M), *a.* crooked. Cf. kauitato.
kakikawi (K), *a.* curly.
kako (M), (? *n.* bone). Cf. tukako.
kamĕka (K), *n.* the scrub turkey.
kamikami (M), *n.* a waterfall.

kanega (F), *n.* carved wooden implement stuck into trophy-skulls (pl. 197, 5, 6).

kani (K) *n.* ginger.

kani (K), *n.* a leprous spot. Cf. nato.

kara (K), *n.* a fence; pari kara, garden fence. Cf. ăra.

karadabutigaut, *n.* a sign, mark. (Mir. atamelam.)

karai (K), *n.* rope. Cf. sawaivi.

karakara (K), *a.* salt; karakar-aba (M), *n.* water not for drinking; karakara obo, salt water. Cf. karokaro, oromoboa.

karakarai (K), *a.* bad.

karamarogo, *v.* to scold, quarrel.

karamtiai (?), isio karamtiai (K), *v.* to carry a child astride on the neck.

karamusio (K), *v.* to kick.

karao (K), *n.* a variety of yam.

kararo (F), *n.* "mask worn by men in last stage of initiation; men are getting on for forty when these are worn; they dance with these on, and are called oboro (spirits), of which women and children are terribly afraid. It is the Semese of the Elema." —Chalmers.

kararu, *n.* a lath.

kararuso (K), *n.* rafters. Cf. kararu.

karatai (K), *v.* to know not, be unable. Cf. umorotato; karatai auera (K), *a.* dumb; karatai dubu (K), *n.* a fool. Cf. dadara dubu.

karaudina, *n.* clothes.

kari (K), *n.* rope.

kariko (K), *n.* calico. The English word.

kari-botama (M), *n.* white cloth. Cf. botama and kea.

karokaro (K), *a.* hot, pungent, of Chili pepper; immature, unripe, green.

karo (F), *n.* small conical fish trap, baited inside, made of "loire palm" (rattan) spines (pl. 194, 6).

karu (?), karu-auana, *n.* sower.

karum (M), *n.* the "iguana," Monitor or Varanus.

kashu (M), *n.* cough. Cf. koseă.

kaua-aupu, *a.* folded; *v.* to fold.

kauarubai, *n.* master, ruler. Mir. sirdam.

kaudo (K), *n.* a top-knot.

kauitato, kawitato (K), *a.* straight; *v.* to square (K).
kauta, *n.* a plank.
kawi (K), *n.* a variety of yam.
kawikaur, *a.* crooked; curly (K).
kea (M), *a.* white.
keakea, *a.* white. Mir. kakekake; *n.* a woman's petticoat (M).
keakea didiri (K), *n.* a white man; keakea dubu (K), *n.* white men; keakea sopu, *n.* whiting, got from Manouetti, and used as paint in dances.
keanenese sirigo (K), *n.* a variety of fibre.
kĕau (K), *n.* a tree frog.
kekuti, *v.* to break.
keneobira (K), *n.* a variety of banana.
kepeduti (M), *n.* the beating of the heart.
kerere (K), *n.* iron. Cf. malili, turika.
kerigedio (KS), *n.* work; *v.* to do work. Mir. dorge, lugem. Cf. erigedio.
kergedioia (K), = kerigedio.
kersemae (M), *n.* the croton.
kes, *n.* a shield. (In MacGregor's Vocab. probably the Motu, kesi, Kerepunu, gehi. Cf. note to gope.)
kigiro, *a.* alive, *n.* life.
kikop (KS) (?).
kimogu, *v.* to bring. Mir. taraisare. Cf. omidai, uabogoi.
kiochi (M), *n.* a little stick for lime.
kiokio, *n.* a piece. Mir. mizmiz.
kiri (K), *v.* to laugh. This is, no doubt, a Motu word, and introduced through Motu interpreters. The proper Daudai word is wari.
kisoede (K), *n.* a venomous snake. Cf. ede.
kitamodiro, *v.* to teach.
kiwura, *n.* the dart of a dugong harpoon. Cf. wap.
kobodo (K), *n.* a variety of sweet potato.
kobokobo, *a.* weak.
kodoboa, *v.* to tempt, to try.
kodoruti (K), *n.* a variety of yam; kodoruti keakea, white yam; kodoruti dogodogo, red yam.
kogomupi (F), *n.* the open end of a pipe, waduru.
koidumo (K), *n.* a variety of banana.

koikumo (K), *n.* a variety of banana.
koimi, *n.* cousin. Mir. kaimeg.
koka, *n.* a dream.
kŏkaiām (M), *n.* the Bird of Paradise; a head-dress made of these feathers, worn in war.
koko (K), *n.* a variety of mango.
kŏkŏwa (K), *n.* a large edible crab.
kokuri (K), *n.* a variety of banana.
kolodiri, *n.* sister. Mir. berbet. Saib. babat.
kolotoi, *v.* to deny.
komogurti (K), *v.* to tremble.
kono (K), *n.* bread. Cf. kunu. This is apparently the same as the Miriam kon, Saibai kona, and a corruption of the English word corn.
kopadi nimabu (MB), *n.* curses.
kopago (M), *n.* a wild duck.
kopo (K), *n.* a piece; *a.* short (K).
kopoa (M), *a.* red.
kopume (K), = kopo, short.
korikori (K), *n.* a parrot.
korio, *n.* a game, play, fun.
korodio (K), *v.* to strike with the fists. Cf. araberŭmo.
korodĭrĭai (K), *n.* a man's elder sister. Cf. mabia, kolodiri.
koromai (?) koromai gido (K), *v.* to call. Cf. wiroro, irumai.
koropa, *a.* sick; *n.* fever (K).
koropoduti (KS), = Mir. akeulam. Meaning not given.
korosodo (Domori), *n.* a head-dress.
korotoi, *v.* to dispute.
korpaguti (K), *n.* skin disease, chloasma; korpaguti magore *n.* ringworm, not scaly.
korutia, *v.* to accuse.
kosa (M), *n.* the seeds known as Job's tears. *Coix lachrymæ.*
kose (K), *v.* to expectorate.
koseă (K), *n.* or *v.* cough.
koteretuti (F), *n.* a kind of arrow.
koumiri (K), *n.* the bough of a tree.
krupu aromo (M), *n.* bêche-de-mer.
krŭti (M), *a.* cranky.

kubira (K), *n.* a bay.
kudu, *n.* voice, tune; ouera kudu, language. Mir kodomer.
kuekere (Domori), *n.* a knife used for cutting off heads.
kuikuĭ-hopo (M), *n.* the heart.
kukra, *a.* lame.
kula (M), *n.* a plate.
kumo (K), *n.* a variety of banana.
kunaro (M), *n.* cinders.
kunu (K), *n.* Indian corn. Introduced. Cf. note on kono.
kuraere (K), *n.* a stone.
kŭrakŭra (M), *n.* a fowl. (Perhaps introduced from Saibai.) Cf. kakaba.
kusa (K), *n.* beads (i.e. seeds of *Coix lachrymæ*. Cf. kosa.)
kuto (KS). Given in Vocab. without Miriam or Saibai equivalent (? a man's end).

Ma (?)
mabi (M), *a.* small.
mabia (K), *n.* a man's younger sister.
mabu, *n.* basis, foundation.
mabu (K), *a.* false; *n.* "gammon," untruth.
mabu-auera (K), *v.* to lie, speak untruths.
mabuedea, *v.* to begin, lit. to put a foundation. Cf. mabu, edea.
mabumaro (K), *n.* a variety of banana.
mabuniuorodu (?), *v.* to pick out at the roots; iăwa mabuniuorodu (K), *v.* to pick the teeth.
mabuo (K), *n.* a shell armlet.
mada (?)
made (K), *n.* a variety of banana.
madia (? madio) madia wowogo (K), *n.* a head-dress composed of a ray of white feathers; madia wowogo pasa (K), *n.* a head-dress of feathers, ten feet high.
madigo (F), *n.* belt worn by all.
madio (K), *n.* a dance.
madira (K), *n.* a yellow dye. Cf. sowora, agoago.
madirimo (K), *n.* a black dye. Cf. uibu.
maja (BM), *n.* a coral reef.
magai (K), *n.* the sugar cane.

magata, *n.* the mouth.
magatasia (K), *n.* the mouth, (magata, and sia, hole).
măgi (M), *n.* the cuscus.
magore (?)
magumo, *n.* the bottom of a thing; (Mir. lokod) magumo-ato, *prep.* under, beneath.
maidek (M), *n.* a petticoat.
maiwas (M), *n.* a small petticoat.
makamak (M), *n.* leglets.
malili, *n.* a sheet of metal. Cf. List of Introduced Words.
mamaru (K), *v.* to spew.
mămŏko (K), *n.* an island.
mamoosi (K), *n.* a chief. Introduced from the islands in the Straits. Cf. note in Miriam-English Vocabulary under mamus, and Introduced Words.
mănăkai (K), *n.* a devil, soul. Cf. urio, and Introduced Words
maniapu (K), *n.* the *Papaya.* (Mammy apple) (?) English.
mao (M), *n.* the neck; mao-kako (M), *n.* the cervical vertebræ.
mapoi, *v.* to name; paina mapoi, *v.* to call by name (Mir. nei atker).
mapu-wara (M), = mabu auera.
marabo (K), *n.* bamboo; obo marabo, *n.* bamboo water-vessel.
marai (KS), *n.* self.
maramu (K), *n.* mother. Cf. aida, ida, mau.
mari (M), *n.* son, boy. Cf. mĕre.
mari (K), *n.* a mirror, looking-glass. Cf. Saibai mari, and maridan in Introduced Words.
mariri = malili.
maru (?).
marugu, *n.* a blade of grass, a shoot. Mir. wai.
masea (K), *n.* a variety of yam.
mataro (K), *a.* calm.
mate, *v.* to deride, to laugh at. Mir. neg.
matigi, *v.* to deceive. Mir. okardar.
mau (KS, K), *n.* mother. Cf. ida, aida, maramu.
mauku (K), *n.* a variety of banana.
maumora (M), *n.* the dugong.
maupo (K), *n.* a butterfly.
maura (K), mauro, *n.* a place, a dwelling place, village. Mir. uteb.

mautu (M), *n.* a house. Cf. moto.
me (?).
megamo (K), *n.* family.
megedubu (K), *n.* an edible snake, venomous and much dreaded.
megemege (K), *n.* a variety of yam.
mekălgămălung (M), *n.* a white man.
menahe, *ad.* secretly.
meragidiro, *v.* to think. Cf. emeragidiro.
mĕre, mĕri, *n.* a child, boy, son; sobo mere (M), *n.* boy or son. Mir. omasker, werem.
merigodoi (?).
miari (M), *n.* the upper part of a water-spout.
mibomibo (K), *a.* difficult, heavy, weighty.
midiri (K), *n.* the name of a shrub; midiri sirigo, *n.* fibre from midiri.
midobo, *ad.* the same, according to (Mir. abkoreb).
mimiamo (F), *n.* image shown at initiation, same as Uvio.
mina, *ad.* again, also.
miniminiai (M), *n.* a small rattan cane.
minoko (K), *n.* a variety of yam.
miradu, *n.* brother. Mir. keimer. Saib. kutaig.
miriuao, *n.* fruit.
miro (K), *n.* peace.
miruu (M), *n.* a sweet potato (D'Albertis); a yam (Beardmore).
miti (K), *n.* root.
mitidiro (P), *v.* to hear. Cf. erauidiro.
mo, *pron.* I.
mo (M), *a.* good; mo buere, *n.* good girl.
mobere, *n.* digging stick and used for fighting by women (pl. 202, 5).
mobini (K), *n.* a species of *Dracæna*.
moboa (?).
mobuo (K), *n.* a dove.
moburo (K), *n.* rain.
modobe, *v.* to complete, fulfil.
modoboima (K), *a.* ten, apparently a hybrid from Daudai, *v.* modobe, and the Motu ima, hand, "completed hand."
mogido, *pron.* to me.

moguru umuru buru (F), *n.* wooden female figure fastened round neck and hangs down in front; girls like young men to wear them. Cf. uvio-moguru, urumuruburu, etc.

moimarai, *pron.* I myself. Cf. mo, imarai.

moini, *v.* to love, to pity.

momi, *n.* to leave waiting. Mir. naokaili.

momo (K), *n.* an edible snake, said not to bite.

momogarina, *n.* fabulous animals like pigs with spiked claws. They live in hollow logs, roam at night, and devour men, pigs, and dogs.—Ann. Rep. 1894, p. 58.

momogo, *v.* to serve. Mir. memeg.

momogosio (K), *n.* a fire-place, made in the house or on a canoe.

momoro (K), *n.* a variety of yam.

momorua (M), *n.* earthquake. Cf. aromorubi.

monobainomi (K), *v.* to stay.

monoboi, *pron.* I here. Mir. kakanali.

mopo, *a.* fastened, fixed; *n.* a knot; *v.* to fasten (K). Mir. mukub.

mora (?). D'Albertis has mora api, stone.

moro, *pron.* my, mine.

moro, *n.* honey.

morogomoa, *pron.* with me. Cf. mo, gomoa.

moromoro (K), *n.* wax knobs on the gama.

moronamiradubu (K), *n.* friend (lit. my countryman.) Cf. moro, namira, dubu.

mosia (K), *a.* that.

mosore, *n.* husk.

motai (M), *n.* a bed.

moto, *n.* a house; a house for women (M); wowogo moto, (K) *n.* a bird cage.

motu (M), = moto.

mou (K), *pron.* I.

mu (K), *n.* the flower of the double red Hibiscus.

muapo (M), *n.* testicles. Cf. muopu.

muba, *n.* a beak; a point of land, cape (K); muba-muso (K), *n.* beard, moustache.

muguru, *a.* tabu, holy, sacred. Mir. zogo. Cf. zugu; hence Oboro Muguru, Holy Spirit. (Mir. Lamar zogo.) Cf. moguru.

muo, *n.* hair. Cf. muso. (Mir. mus.)

muopu, muhopo, *n.* the testicles; scrotum (K); muopu ra sigiri (K), *n.* elephantiasis of the scrotum.
mure, *v.* to be silent, to hold one's peace. Mir. bazeguar, bamer.
mureso, *a.* far off, distant. Mir. muriz-ge.
muru, *a.* knowing; muru auana = Mir. le pardali, *n.* a wise man.
musiboo (M), *n.* or *v.* whistle.
muso (K), *n.* hair.
muto (K), *n.* a variety of yam.
mutu (?), mutu dubu, *n.* master, owner. Mir. kem le; dirimoro mutu dubu, *n.* owner of country; namutu dubu, *n.* a native thing.

Na, a *possessive suffix* to nouns.
nagoria, *v.* to be grieved.
nai (K) (?), nai tawatawa (K), *ad.* here. Cf. noboi rom.
nairi (?)
nakobokoba (?)
namabu = numabu; namabu owaigati (K), *n.* work.
namaderagediai (K), *v.* look here!
namira (K), *n.* one's native place; country.
namu (K), *n.* a man or woman's elder brother. Cf. niragerema.
namutu-dubu, *n.* a native thing.
nani (K), *a.* true.
nanihe, *a.* true, to be depended upon.
nanito, *n.* always. Mir. niai karem.
nanito (K), *n.* this way.
nao (K), *a.* one.
napar. Cf. era, eranapar.
naramdu, *n.* the eldest child. Mir. narbet. Saib. kuikuigö.
nari (?)
nati, *n.* a mosquito.
nato, *n.* a wound; a cicatrix; leprous spot (K). Mir. ziz. Cf. bugomu. kani.
natura (K), *a.* another.
naturai, *a.* only, alone. Mir. tebteb.
naturaimi (K), *a.* another, different. Cf. ata, natura.
nau, *a.* one.
nau-ouputo, *v.* to assemble (lit. to be in one place, Mir. netat gedim).

nauto nari (K), *a.* all the same. Apparently nau, tonar, wrongly divided.

ne (?) *n.* excrement; arima ne, *n.* dysentery.

nebeta (K), *pron. interr.* what is this?

nebetaro (K) = nebeta.

nebetaromi (K), *ad.* there.

nei, *pron.* they.

neigido, *pron.* to them.

neina, *pron. poss.* theirs.

neitararoro, *pron.* they two, those two. (Mir. ui darali.)

nemabu (K), *n.* a thing. Cf. numabu.

nepiri (F), *n.* a notch cut in a bamboo beheading-knife; each notch indicates that a head has been cut off.

neragiwai, *v.* to stumble.

nese (K), *n.* pearl shell; nese gege, *n.* a pearl-shell breastplate. nese orogori, *n.* a pearl necklace.

netewa (K), *a.* two. Cf. netoa.

netoa, *a.* two. Cf. netewa.

netowa = netoa.

ni (?)

nibo, *v.* to stink. Mir. semelag; *v.* to smell (K); gamăsa nibo (K), *n.* stink.

nibonibo (?) piro nibonibo, *v.* steal greatly (?). (Mir. au eruam.)

nibonibo (K), *n.* a smell.

nigo, *pron.* you; your.

nigoibi (K), *pron.* you three.

nigoto (K), *pron.* you two.

nigosirio (K), *pron.* you all. Cf. sirio.

nimairi (?)

nimidai (K), *v.* to buy. Cf. uosa.

nimo, *pron.* we.

nimo (K), *n.* a louse. Cf. nimu.

nimogido, *pron.* to us.

nimoibi (K), *pron.* we three.

nimona, *pron.* our.

nimoria, *v. plur.* to give. Cf. agiwai, ua, uosa.

nimosirio (K), *pron.* we all. Cf. sirio.

nimoto (K), *pron.* we two.

nimu (K), *n.* a flea.

niragerema (K), a man or woman's younger brother. Cf. namu.

nirimagari (K), *n.* a present. Cf. nirimogari.

nirimogari, *v.* to pity. Mir. omare. Cf. moini.

niriso, *v.* to eat. Cf. Grammar.

niro, *n.* the inside, the belly, bowels, entrails, tripe (K). (Mir. Saib. mui); niro-ato, *prep.* in the inside, within; niro temeteme (K), diarrhœa or stomach ache.

nirubiro,

nitago-ogo (M), *n.* coming.

nitara (K), (?) nitara wămĕai (K), *v.* to return.

niti (?)

no, *conj.* that, so that.

noadu, *v.* to give.

noboi, *ad.* here, there.

noboirom (K), *ad.* here. Cf. nai tawatawa.

nogerebu (K), *n.* a generation.

nogereburo (K), *n.* an uncle.

nogodumo, *v.* to go.

nogomoa, *pron.* with him. Cf. nou, gomoa.

nogu (?)

noimarai, *pron.* himself.

nono, *ad.* there, *pron. demons.* he there. Mir. peike, pedali.

noŏra, *n.* coral. Cf. nora.

noosa (K), *v.* to give. Cf. agiwai, ua, uosa, nimoria.

nopo (M), *n.* the tail of a fish; the handle of a spoon.

nora, *n.* a stone; nora-api (M), *n.* stone.

nori (K), *n.* a sweet potato; nori agurubai, *v.* to dig sweet potatoes.

noridori (K), *v.* the tide comes in.

notiderai, *v.* to bring.

nou, *pron.* he.

nouea, *v.* to espy (*sing.*). Cf. ouea.

nougaut, *pron.* from him.

nougido, *pron.* to him.

nouido, *ad.* so much. Mir. absaimarsaimar.

nouna, *pron.* his.

nouororo, *a.* like in features. Mir. kaise.

nowai (K), *n.* the Polynesian chestnut.

nuairomi (K), *ad.* whether, or.
nuku, *n.* a dish. Mir. tanelu.
numabu, *n.* any thing, thing; numabu mutu dubu, *n.* owner of property. Mir. lukem le.
numada, *conj.* if, though.
nuna (K), *a.* edible; *n.* a thing.
nunamabu (K), *pron.* what?
nupu (K), *n.* tail = nopo.
nusăso (K), *v.* to cut up, chop; era ota nusăso, to cut up firewood.

Oa, *v.* to give. Cf. ua, uosa, agiwai, nimoria.
oa, (M), *n.* a sail; turi oa (M), *n.* the foresail; wami oa, (M), *n.* the jib; wapu oa, (M) *n.* the mainsail.
oagoberaĭ (K), *a.* square. Cf. kauitato.
obera (M), *n.* speaking.
oberi (K), *n.* bush men.
obira, *n.* banana.
obiriodoi, *v.* to undress.
obo, *n.* fresh or drinking water; wade topo obo (K), drinking water; obo tao gomia (K), *n.* flood; auo obo omio (K), *n.* flood tide, (deep water stays); ekebure obo, *n.* shallow water; obo durugere, *a.* thirsty; obo airodori, *n.* ebb tide (water to shins); obo iroridoro, *n.* flood tide (water drowns).
oboro, *n.* a spirit, a ghost; obora-tama, shirt, a sash, cloth, lit. ghost-skin.
oboronepe (K), *n.* a variety of banana.
oboturao (M), the wind-pipe.
obu buru, *a.* empty.
odarai, *v.* to put in, to lay in.
odio (M), *v.* to do, to make.
odio, *v.* to eat, to drink, to smoke tobacco in Papuan fashion by swallowing the smoke; to dine (K); obo odio (K), *v.* to eat water, to drink; tutu odio, *v.* to drink from the hand.
odiodoi, *v.* to touch.
odiro (?)
ododa (K), *v.* to beat; gama ododa, to beat a drum.
odomuto (K), *n.* a variety of yam.
ŏdoŏdo (M), *n.* the breast.

odoro, *v.* to enter, go in; eaten (K).
odotorapi, odotorupi, *n.* the tongue. Cf. watatorope.
oduara (K), *n.* the collar bone.
odumu (K), *v.* to shrink.
oea (M), *n.* looking, guarding.
ogeribai (M), *v.* to catch. Cf. ogu, erabai.
ogirio, (K), *v.* to crawl.
ogomu (K). *n.* the cheek.
ogu, *v.* to go; to come; to walk.
oguitogu, *v.* to go.
ogunita = Mir. kei tabakeam (? to go forth).
ogurumo, *v.* to spread.
oi, *n.* a coconut; oi baribari, a young nut; oi samaga, an old nut; oi (M), *n.* a coconut shell; oinimo, coco fibre; oi mosore, coconut husk; oi mosore sirigo, fibre made from husk; oi obo, coconut milk; oi sugu, coconut cloth; oi pari, coconut grove.
oio (P), *n.* a young man. (Mir. makeriam, Saib. kernele). Cf. osio.
oiobai, *v.* to take up.
oisusuopu (K), *n.* kidney. Cf. oi, susuopa.
oiti, *ad.* then.
oiwo, *n.* grief; oiwono nagoria, *v.* to be grieved. Mir. okasosok, okabatageli.
oiwoĭi (K), *a.* lazy.
omia (M), *n.* sitting.
omidai, *v.* to bring, carry, take up; to find (K).
omidiro, *v.* *imperative*, stay here! you stay! Mir. nawa.
omiei, *v.* to sit, stay, stop; poputo omiei, *v.* to sit on the knees.
omio, (K), *v.* to kneel.
omioi (K), *v.* to stop; auo obo omio (K), *n.* flood tide, lit. deep water remains.
omo (P), *a.* short. Cf. sopuimi.
omo (K), *n.* a green ant.
omogu, *v.* to carry, receive.
omoriti, *v.* to prune, thin out. Mir. paret.
omu, *n.* a boundary.
onatato, *n.* open. Mir. paret kak.
oosa (K), *v.* to give; wisa oosa (K), *v.* to pay. Cf. agiwai, noosa, uosa.
opai, *v.* to shut.

opia (K), *v.* to kill = opio; didiri opia, *v.* to murder; didiri opia dubu, *n.* a murderer.

opio, *v.* to strike; opio para, *v.* to kill. (Mir. ipit.)

opito, *v.* to grow. Mir. omeili.

opo (?)

opu, *n.* soil, land, earth; the world.

opuo (M), *n.* yam.

oputi, *v.* to count.

ora, *v.* to seek, to look for; ebiari ora, to be unable to find. (Mir. nab deraimer.)

oradubu (KS), *n.* the word used in the translations for God. Cf. aramorubi. Oraoradubu is another name for uvio-moguru.

oraruo (K), *v.* to take down; tiro oraruo, *v.* to take down sails. Cf. ororua.

oriai (P), *a.* dead. Cf. orichiai.

oribo, *v.* to rise.

oriboa (M), *n.* standing up; *v.* to get up.

oribōo (K), *v.* to wake from sleep.

orichiai (KS), *a.* dead; *v.* to die. Cf. oriai.

oridiro (?)

orimiriti, *a.* dead.

orio, *a.* new, clean, fresh.

orio (K), *v.* to blow; tuture orio, to blow the tuture.

oriodoi, *v.* to return, retreat. Mir. takomeda.

oriomu (K), *n.* a variety of banana.

ŏriora (M), *n.* the first of the south-east monsoon.

oriou (F). Cf. ouou.

orirai, *v.* to remain.

oritorai, *v.* to rise up; airi oridiro (K), *v.* to rise, of the sun.

orkienkok (M), *n.* the hornbill.

oro, *n.* bone. Cf. soro.

oro, *n.* the sea. Cf. uro.

orŏbai, *v.* to catch, to grasp; to carry in the hand (K). Cf. erabia. (Mir. erpei); usaro orobai, (K), *v.* to hunt kangaroos.

orobere, *n.* saliva.

orobo, *n. sing.* a woman, wife, spouse. Cf. upi.

órodai, *v.* to meet. Mir. obapit.

orodai (?) = Mir. babisdari.

orodobi, *v.* to set (of the sun).
orodu (K) (?), pe orodu (K), *v.* to pole a canoe.
orogiama, *v.* to touch.
orogori, *v.* to put on (clothes); nese orogori, *n.* a (pearl) necklace.
oroguriato, *v.* to bow the head.
orogurio, *v.* to stoop.
oroi (M), *n.* a star.
oromai, *v.* to shout, to call to.
oromaturuo (M), *n.* the œsophagus.
oromiado (P), *v.* to sit.
oromidi, *v.* to strike, scourge.
oromo (K), *n.* a river. Cf. goua; oromo turi, *n.* a creek; oromoito, to deep water, a term used in steering. Cf. ito; oromo damo, *n.* ocean.
oromobo, ororomoboa, *n.* the sea; sea or salt water (K).
oromoria (M), *v.* to share out.
oroomai, *v.* to be silent, quiet.
orooro (K), *n.* a thorn.
oroöti, *a.* full. Mir. mitkar, osmeda.
oropio (K), *v.* to smash.
orori (?), orori mawa (K), *n.* the howl of a dingo.
ororo, *n.* the face; the front of anything; moto ororo, the door, the front of the house. Mir. op meta.
ororua, *v.* to come down.
ororuso (K), *n.* meeting.
orosa (K), *n.* sweat.
orosidiro (K), *n.* the shoulder.
orosiodiro, *v.* to make or get ready.
oroto, *v.* to weep.
orotodum, *v.* to weep.
orourai (K), *v.* to prick with spear.
orowoduti, *v.* to ooze.
oruria, *a.* withered.
oruso (K), *v.* to chew.
osa (K), *n.* the joining of point to arrow.
osio (KS), *n.* a young man, youth; osio (K), *n.* an infant; osio-mere, male baby; osio-besere, female; (F) uninitiated lad. Mir. makeriam, Saib. kernele. Cf. oio.

osĭo (K), *n.* a wound.

osomĕai (K), *v.* to lick. Cf. osomiai.

osomiai (K), *v.* to kiss.

osoruo (K), *v.* to go down, to go outside.

osua (K), *n.* the heavens. Cf. ou.

osua (K), *v.* to put up, *ad.* upwards; tiro osua, *v.* to put up sails.

osuderuti (K), *v.* to sweep.

osupata (K), *n.* the instep.

ota, *n.* a tree; wood, flagstaff (K); ota tama, bark; ota arima, gum, sap. Cf. peĕre, soro.

otăauti (K), *v.* to divide.

otai-hopo (M), *n.* the loins.

otakapuki (K), *n.* the heart. Cf. tusuopu.

otaota (F), *n.* nose ornament worn by women when dancing (pl. 194, 1, 2).

otapara, *a.* dry (lit. dead wood). Cf. ota, para.

otigi, *v.* to put forth.

oto, *n.* the thumb; oto-turi (M), *n.* the forefinger.

oto (K), *n.* a wooden or steel adze for sago making. Cf. otoai.

otooto (Domori), *n.* a kind of arrow, with numerous barbs.

otoai, *v.* to split, cut, divide.

otoboa, *v.* to stand up, arise. Mir. tekue.

otoi, *v.* to leave, put aside.

otoirai, *v.* to bind. Cf. itoiriti.

otoiriti (M), *v.* to make fast a rope. Cf. otoirai, itoiriti.

oto sairo (K), *n.* shoes.

ototoro, *v.* to break, rend, tear.

otŏuri (K), *v.* to stamp with the foot.

otumai, *v.* to send away.

otuturo, *v.* to stretch forth.

ou, *n.* sky, *a.* high; *prep.* ou-ato, at the top, above. Cf. osu.

ouea, *v.* to espy, to see (*plur.*). Cf. nouea.

ouera, *n.* a word; ouera kudu, language; oueramito, things = Mir. merkem. Same as auera.

ougi, *v.* to follow.

oumiriti, *a.* dead (of things). Mir. eumilu lu.

ouou (F), *n.* ear pendant used as a weight to distend the lobe of the ear (? oriou), (pl. 190, 1–4).

owaigati (K), namabu owaigati, *n.* work.

Paa = paha.

paara (K), *a.* dead. Cf. para.

padi (K), *n.* the brown cuscus; uibuuibu padi, the black cuscus; keakea padi, the white cuscus. Cf. parima.

pae, *n.* a great number, a lot; *a.* plenty. Mir. lakub.

paha, *a.* equal, like, accompanying; *prep.* along with. Cf. pope. Mir. kemem, okakes.

pai, *ad.* no, not; (used before other words). Cf. puai; pai diriuo *a.* unwilling.

paii (F) a Kiwai pillow made from sago palm.

pai auri dubu (K), *n.* a blind man. Cf. idamari, auri.

paina, *n.* a name.

pako, *n.* a sound; *v.* to explode (K).

papu (M), *n.* the knee. Cf. popu.

paputa, *n.* a porch. Mir. maisu.

para (P), *v.* to die; *a.* dead. Cf. uparu, paara.

para, *a.* ripe.

parako (K), *n.* a variety of sweet potato.

paramuti (K), *n.* burnt corkwood; paramuti uibu (K), *v.* to paint body black for dancing.

parani (K), *n.* a net for fish.

parapara (M), *n.* the lungs. Cf. barahoro, barasoro.

pari, *n.* a plantation, a garden; pari goua, *n.* a ditch or drain.

parima (M), *n.* the cuscus. Cf. padi.

paromiti (F), *n.* a wooden female image shown only once a year at the initiation ceremony. It is kept wrapped up in tiro matting (pl. 195, 3). Cf. uvio moguru.

paruiana (F), *n.* a kind of arrow.

paruparu, *n.* elephantiasis of the leg.

pasa, *n.* a leaf. (Mir. lam. Saib. nguzö); a feather (K). Cf. gorŭmŏ.

pasaro, *n.* hill, mountain. (Mir. paser). As there is only one small hill, Mabudauan, in the whole of Daudai, this word is probably introduced from Miriam. Cf. podo.

patara (K), *n.* the platform or deck of a canoe; a raft.

pate (K), *n.* a bell. A Lifu word introduced from Miriam or Saibai.

pato (K), *n.* a variety of yam.

patu (?)

patura (K), *n.* breadth.

paudo (K), *n.* a treaty. Cf. Mir. paud, Saib. pautö, from which this is probably introduced. The proper word is miro.

pauna, *n.* skin (of an animal). Mir. paur.

pauŏko (K), *n.* a cloth worn as a kilt.

paŭoro, paŭoro gagari (K), *n.* a gun; paŭoro, Eng., powder, gagari, bow.

pe, *n.* a canoe or boat; ekeeke pe (K), a whaleboat; auo pe, *n.* a ship; era pe, *n.* a steamer.

peba (K), *n.* a book. The English word "paper."

pĕdua, *v.* to shoot. Mir. itimed.

peĕre (K), *n.* wood. Cf. soro, ota.

pekupe (F), *n.* jew's harp played by young lads (osio). Cf. begube (pl. 197, 4).

pere, *a.* the left side; pere tuo, the left hand.

peredara (K), *n.* a variety of sweet potato.

piago (F), *n.* pan pipes.

pida (K), *n.* a torch made of coconut fronds.

piperiti, *v.* to squeeze. Cf. amahiri.

pipiauri (K), *n.* a black duck.

pira (M), *v.* to have none.

piro, *v.* to steal; piro nibonibo, to steal greatly. (Mir. au eruam.)

piro (? *n.* wing); piro păsa (K), *n.* a wing feather.

pitu (K), *n.* the buttocks.

pitu (K), *n* .the nails; sairo pitu, toe-nail; tugiri pitu, finger-nail; oto pitu, thumb-nail.

pitupitu (K), *n.* a species of beetle.

piu (K), *n.* the midrib of a leaf.

piu (K), *n.* the cross beams connecting the outrigger float with the canoe; thwarts.

piuri (K), *n.* an armlet made with *Coix lachrymæ*; (F) the cross-shoulder belts and armlets decorated with coix seeds worn when going to fight.

piuri (K), *n.* a variety of yam.

po, *n.* song; po-abo, *v.* to compose a song. Cf. poho.

poa (M), *n.* nothing. Cf. puai, pua; adina poa, *a.* no good.

poa (K), *n*, a skin disease, *Eczema marginata;* ringworm.

podo (K), *n.* a hill. (Saibai pada.) Probably introduced. Cf. pasaro, and note.

poduti, *v*, to tear, to destroy.
poho, *n*. a song, a word; tune (K). Mir. wed. Saib. na.
poniponi (M), *n*. lightning.
poo = poho.
poitoi-ita (M), *v*. to keep off the wind, in sailing. Cf. poto.
pope, *a*. along with, equal. Cf. paha. Mir. okakes.
popo (K), *n*. a bale, bundle; sukuba popo, *n*. a cigarette.
popu, *n*. the knee.
popuipa (K), *n*. the knee, = popu.
poputo-omiei, *v*. to kneel, *lit*. to sit or rest on the knees.
poputomioi (K), *v*. to kneel, = poputo-omiei.
poro (K), *n*. an edible snake, said to be very fierce.
poto (? *n*. shallow water); potoito (K), *n*. to shallow water, in steering.
poto (?); poto bato (K), *n*. a belt. Cf. bata.
potoraimi, *a*. four, given in Rev. E. B. Savage's Voc. as the equivalent of the Mir. neis a neis, two and two.
pou (K), *n*. the Biri palm; pou sirigo, *n*. fibre made from pou leaf.
poubari (K), *n*. plaited rope.
pua = puai.
puai, *ad*. no, not (used after other words). Cf. pai, poa.
puda (M), *n*. the handle of a club.
pukai (K), *ad*. = puai.
pupu (K), *n*. or *v*. fan.
puripuri, *n*. magic, witchcraft.
puruao (F), *n*. a headdress from Debiri (pl. 191, 5).

Ra (?)
ragotogo (K), *v*. to beckon to anyone to go.
raguta (K), *v*. to carry on the shoulder.
rarugoro (?)
reresebo (K), *n*. a joint.
ro, *pron*. thou, you (*sing*.).
ro, *prep*. with.
roă (?)
robeturo (?)
rodiro (?)
rodori (K), *v*. tide goes down river.
rogomoa, *pron*. with thee. Cf. ro, gomoa.

rogu (?)
roriro (K), *v.* tide goes up river.
roro, *pron.* thine, your (*sing.*).
rorodi, rorodia (P), *a.* all. Mir. uridili. Cf. tuturumi.
roro-oto (K), *v.* to grow.
rorota (K), *n.* birth.
rosidiro-auana, *n.* a writer, scribe. Mir. aotale.
rukupo, *n.* medicine, paint. Mir. lukup.
rupi (K), *n.* a venomous snake, edible.

Sabi, *n.* tabu, prohibition, law; *v.* to tabu. Perhaps a Saibai word.
saemiti, *n.* corkwood (burnt) to blacken the face.
sagana (K), *n.* the moon; sagana gege, crescent moon. Cf. gege; dogobe sagana, full moon; sagana suokara, a halo round the moon.
sagarunepe (K), *n.* a species of snake, probably a lizard resembling a snake.
sagigi (M), *n.* a swelling.
sai (KS), *n.* daylight; sun, day (K); sai sirio, *ad.* daily; sai epi, *n.* noon; sai iri sukumai, the sun sets. Cf. iuio.
saimabu (K), *n.* a watch (time-piece). Cf. sai, mabu.
saipo (K), *n.* a dance, hopping on one foot.
sairidoro (K), the shins.
sairigiri (K), *n.* trotters (foot-claw). Cf. sairo, igiri.
sairo (K), *n.* the foot, leg. Cf. aira, airo; sairo oto, *n.* a boot; sairo pata, *n.* the sole of the foot.
samaga, *a.* old, of coconut.
sami, *n.* bad spirits, in the form of dwarfs, with immense heads. They carry large bows and arrows, are blackened with charcoal, and decorated with cassowary plumes. They can endow men with power of flying, cause snakes to bite and kill, pigs to destroy gardens, winds to wreck and drown.—Ann. Rep. 1894, p. 58.
samo (M), *n.* a cassowary.
samo (K), *n.* a feast.
samo, *n.* pride, boasting; samo patu, *v.* to be very proud. Mir. au bauspili.
samoito (K), samuito, *a.* quick; *v.* to hasten. Mir. sobkak.

samuitoi, *v.* to be quick. Mir. kabdigili.
sana (M), *v.* will give.
sano (M), *n.* the tail of a quadruped. Cf. nopo.
sapua (K), *n.* a side, remnant; ere sapua, sapua nao (K), *n.* half.
saputa (K), *n.* or *v.* purchase.
sarima (K), *n.* the outrigger float. Cf. Mir. and Saibai.
sarimïsa (M), *n.* a coloured man.
sarina (K), *n.* a traitor.
sarugosio (K), *n.* the nostrils.
sarusaru (K), *n.* a centipede.
saso (K), *n.* taro.
saui, *n.* a post.
savori e ipa (F), *n.* shell used in sharpening a bamboo knife (weri).
sawa, *n.* canoe; sawa ota, *n.* the mast of a canoe; sawa tiro, *n.* the sail of a canoe; sawa ivi, *n.* the stays of canoe mast; sawa peere, *n.* wooden step used for supporting the mast of a canoe (pl. 194, 3).
sawaivi (K), *n.* a cord made of split creeper.
sawasawa (K), *n.* twilight.
sebeda (K), *n.* a land shell.
segudo (K), *n.* a dragon-fly.
sene (K), *n.* a variety of yam.
seneniti (K). *n.* an iron anchor.
sepate (K), *n.* the lobe of the ear. Cf. epate, gare.
seporo (K), *n.* a cigar wrapper.
sera (K), *n.* breath. Cf. era, hera.
serao (K), *a.* wild; *n.* work.
seratato, *a.* continuous, lit. without stopping to breathe. Mir. nerkak.
sere, *n.* a net.
si (M), *v.* be quiet! hush!
sia (K), *n.* the south-west; sie rarugoro, *n.* the south.
sia (K), *n.* a hole (in lobe of the ear); wadi sia, *n.* a hole in the septum nasi. (F) the hole in a bamboo pipe in which the bowl is inserted.
sia (K), *n.* a nut used as a rattle in dances.
siahu (K), *n.* a large bale of sago.
sibara (K), *n.* a crocodile; a variety of banana.
sibo (K), *n.* the lungs. Cf. torutoru.

sibomuguruti, *v.* to believe; (Mir. oituli); pai sibomuguruti, *v.* to disbelieve. (Mir. watur kak.)

sidiro (?)

sido, *n.* the spirit which controls death.

sidobari (K), *n.* the croton.

sido oradubu, *n.* God.

sie (K), *n.* the west. Cf. sia, irarasukumai.

siea (?)

sige (M), *v.* to finish. Cf. tau.

sigiri (? *n.* swelling); muopu ra sigiri (K), elephantiasis of scrotum.

sigubia (K), *n.* a variety of banana.

sihua (K), *n.* a bale of sago.

sikara (K), *n.* the crayfish.

simarai, *pron.* himself.

sime (K), *n.* a variety of banana; sime sirigo, *n.* fibre from banana stem.

simera (KS), *pron.* yourself, thyself (in Text No. 19).

sio (K), *n.* dog.

siö (KS), *a.* fast, quick. (Mir. wamen.) Cf. iö.

siremasepate (Domori), *n.* a kind of arrow.

siri (K), *n.* the Chili pepper.

sirigo (K), *n.* flesh; fibre of plants. For varieties of fibres see: guri, idi, keanenese, midiri, oi, pou, sime, sosome, taga, toma, turio.

sirio, *a.* many, all. Cf. irio.

siripo (K), *n.* shame. siripo ia, *a.* ashamed.

siro = sirio.

siro (K), a myriapod (*Iulus*).

sisiasisia (K), *a.* light green. Cf. ipauipau.

sisiuna (K), *n.* a parrot.

sito (KS), *n.* the outside. Cf. sugu.

sito (K), *n.* a basket made of coconut leaves. Cf. ito, tito.

siuia kikop, *a.* thorny, prickly. Mir. zigerziger.

so (Domori), *n.* ornament of strips of dog's skin, fastened in girdle behind and worn in dances (pl. 192, 5).

sobo, sobu, *a.* small, little; sobo mĕre, *n.* lad, boy; sob ota, *n.* a little thing.

sobomara (K), *n.* a variety of banana.

sobu mere (K), *n.* an idiot. Cf. sobo.

sodo (K), *n.* a cartridge.
soge (K), *n.* the flying fox (*Pteropus*).
sogere (K), witchcraft. Cf. puripuri.
sogeri (K), *n.* armlets and leglets of twine; (F) worn by widows round neck, hanging down back and front, when in mourning for husbands.
soke (K), *n.* a variety of banana.
sokeri (F), *n.* arrow used for long distances.
soki, *n.* a stick to husk coconuts with; a walking stick, a staff.
sopu (K), *n.* clay; uibuuibu sopu, black clay for painting the body, obtained at Kiwai; dogodogo sopu, red clay from Dudi.
sopuanotoi (K), *n.* Hell.
sopuimi (KS), *a.* short. Cf. omo.
sopunii (K), *n.* a snake, said not to bite.
sorea (K), *n.* a snake, said not to bite.
soro (K), *n.* bone; shell; wood after the bark is peeled off; ipa soro, clam shell, (F) used as a knife for taking out the kernel of the coconut.
sosido (K), *n.* a variety of banana.
sosome (K), the hibiscus, *Hibiscus tiliaceus* (Fiji, Vau.); sosome sirigo, *n.* fibre from the hibiscus.
sosoro (K), *n.* the forehead.
sosugoro (K), *n.* ear ornaments of worsted or twine.
sou (K), *n.* famine.
sowora, sowore (K), turmeric, used as a yellow dye. Cf. agoago, madira.
suabi (K), *n.* grasshopper.
suagŏ (K), *n.* grass; suago pasa, grass leaf; suago miti, grass root.
sugu (P), *n.* the outside. Cf. sito.
sugu (K), *n.* coconut cloth.
sugumai (K), = *n.* sukumai; era sugumai (K), *n.* sunset.
sukŭbă (K), *n.* tobacco; sukuba popo (K), *n.* a cigarette, lit. tobacco roll.
sukuba (K), *n.* scaly ringworm.
sukumai (K), = sugumai, *v.* to set, of the sun; irăra sukumai, the west. Cf. sie, sia.
sungei (M), *n.* the cane sling by which heads are carried.
suokara (K) *n.* a halo.

sura (M), *n.* a flower.
suroma (K), *n.* the north or north-west.
suru (M), *n.* beacon, a mark.
susa (K), *n.* a land shell.
susi (K), *v.* to sit.
susu (K), *n.* bladder.
susu (?), susu rarugoro (K), *n.* the south-east.
susua (K), *v.* to blow; susua epuro, *v.* to blow with the mouth.
susuo (K), = susua; auo susuo, *n.* a gale, lit. big blow.
susuome, susuomi (K), *n.* a fly; the house fly.
susuome (F), *n.* an arrow with a sharp conical tip which breaks off in the wound.
susuruwia (K), *n.* a rainbow.

Tabaro (K), *n.* a mat.
taga, *n.* the pandanus root; taga sirigo (K), fibre from pandanus root.
tagaa (M), *ad.* a long time ago. Cf. tagara.
tagara, *a.* old; *ad.* formerly, a long time ago; tagara ia, *ad.* from of old.
tagaraimi (K), *ad.* formerly; tagaraimi gogu, *ad.* long ago, lit. going a long way back.
tagu, *n.* time.
taira (K), *n.* a cobweb.
taiua, *n.* a rock. Mir. neid.
tama (M), *n.* skin; ota tama, *n.* bark; oboro tama, *n.* cloth, a sash. C. esume.
tamai (KS), *ad.* openly.
tamari (?), tamari muba (K), *n.* a snout.
tamatama, *a.* thin, lit. skinny. Cf. tama.
tamo (M), tamu (K), *n.* wing of a bird.
tanar, *n.* custom, habit, fashion. Mir. tonar.
tanu (?), tanu-auana, naked.
tao (K), *v.* to finish. Cf. tau.
tarame (K) (?), dou tarame, *n.* sago in a small roll. Cf. siahu.
tararoro (?), nei tararoro, *pron.* they two. Savage MSS.
tariguro (?)
taro (K), *v.* to come.
taropura (K), *n.* a bottle for lime, a glass bottle. Perhaps introduced from Miriam tarpor.

tatamu (M), *n.* the chin, lower jaw.

tatari, *a.* near.

tatarito, *inter.* a form of greeting. (Mir. maiem.)

tataritu (K), *v.* he comes.

tato, *suffix* no, not. Mir. kak. Saibai igi.

tau, *v.* to finish; sign of the past tense.

tau ima godio (K), *v.* to swallow.

taugo, *a.* first.

tawatawa (?), nai tawatawa (K), *ad.* here. Cf. noboi rom; tawatawa tuturu (K), *n.* the world.

tea, *v.* to stand. Mir. akur.

teapariato, *n.* grass. Mir. soge. The Daudai word is apparently a compound of tea, 'stand,' pari, 'garden,' ato, 'in.' The proper equivalent of soge is suago. In the MS. translation appended to the Daudai text, teapariato is explained as 'in a barren place.'

teere (F), *n.* collective name for arrows.

tema, era tema, *n.* smoke.

tĕmatĕma, *a.* painful, sick, sore; *v.* to suffer pain; *n.* disease.

temeteme = tĕmatĕma; niro temeteme, *n.* diarrhœa or stomach ache.

tepe (M), *n.* fresh-water bivalves; mussel.

tepere daredare (K), *n.* a bird, the spurred plover.

tepetepe (?), tepetepe terisi awado (K), *v.* to flog.

teraiai (Domori), *n.* a kind of arrow.

tere (K), *n.* an arrow. Cf. were, teere.

tere (K), *n.* flooring made from the Te palm.

tereniri (K), *n.* a species of *Dracaena*.

terisi (?), tepetepe terisi awado (K), *v.* to flog.

tĕrik, tĕriko = turiko; tĕrik-arubi (M), *n.* a white man; tĕriko-gagari (M), *n.* gun.

tĕriko (MB), *n.* tomahawk.

tete (K), *n.* a fish spear; epeduai *v.* to spear with the tete.

tibi, *n.* root.

tidi (K), *n.* a species of gourd.

tigiri, *n.* the shoulder, shoulder joint; tigiri-kako (M), *n.* the shoulder blade; tigiri soro (K), *n.* the shoulder blade.

tigiro, *n.* the brain.

time (?).

tirikarubi, *n.* a white man. Cf. tĕrik.

tiro (K), *n.* a mat made of broad strips of the leaf of the pandanus fastened together, used for sleeping mats and sails; tiro oraruo, *v.* to take down sail; tiro osua, *v.* to put up sail; sawa tiro, *n.* a sail. Cf. oa.

titi (K), *n.* a basket made with a small and fine plait. Cf. ito, sito.

titi (K), *n.* a carving on wood, *v.* to tattoo.

titi (K), *v.* to smear, to paint, to rub, into the skin as ointment; gato titi, *v.* to smear with mud in mourning; titi rosiodiro, *v.* to write.

titi (K), *a.* beautiful, smart, "flash."

tiwa (K), *n.* the pole for poling a canoe.

toabuti (K), *v.* to bite.

toboro, *n.* a cloud.

togiri, *a.* trembling; *n.* palsy.

toia (K), *n.* foam.

toka (K), *n.* a lime spoon.

toma (K), *n.* bread fruit; toma sirigo, *n.* fibre made from breadfruit. "The seeds are eaten, but the pulp is usually thrown away." —MacGregor, Rep. 1890, p. 40.

tooto (Domori), *n.* a wooden implement used for opening coconuts. Cf. oto (pl. 194, 5).

topo (K), *n.* food; good (M); wade topo obo, topo opo, (K), *n.* drinking water. Cf. tupobo.

topo (K), *n.* a venomous snake.

tore, *a.* frightened, afraid; *v.* to be afraid; *n.* fear.

torĭbo (K), *n.* twins.

torope,

torotoru (K), *ad.* light.

torutoru, *a.* easy, light. Mir. perper.

torutoru (K), *n.* the lungs. Cf. sibo.

toto, *n.* an iron nail.

toto (K), *n.* a ladder (staircase).

totoboa, *v.* to stand.

totoma, totomo, *v.* to exhort, preach; *n.* a story, a tale (K).

totototo, *a.* sorry, grieved.

tsime (KS), *n.* a banana. Cf. sime.

tu (M) = tuo.

tuburo (M), tuburu, *n.* the inside (Mir. teibur); the stomach (K).
tudi (M), *n.* a fish-hook; irisina tudi (K), *n.* a fish-hook.
tue (K), *n.* the fore-arm.
tugiri (M) = tuigiri.
tugu (K), *n.* the sticks fastening the piu to the sarima.
tuhai (M), *n.* veins.
tuigiri (K), *n.* the hand. Cf. giri, igiri, tue.
tuiopo (M), *n.* the finger. Cf. tue.
tuipikako (M), *n.* the ulna.
tukako (M), *n.* the shoulder.
tumaho (K), *n.* the wrist.
tumanababa (K), *n.* a stone club with star shaped disc.
tumanua (K), *n.* a fresh-water turtle.
tumodi, *a.* right, on the right side; tumodi tuo, *n.* the right hand.
tumodia (M), *v.* to go straight. Cf. tumodi.
tumi (K), *n.* a mushroom.
tumu, *n.* the bush, forest, uncultivated country. Mir. sumez.
tuo, *n.* the forearm and hand; tumodi tuo, *n.* the right hand; pere tuo, *n.* the left hand. Cf. tue.
tuo (K), *n.* ashes.
tupata (M), *n.* the hand.
tupi (K), *n.* the upper arm.
tupoa (K), *n.* the elbow.
tupobo (M), *n.* drinking water, fresh water. Cf. topo, obo.
tupopo (M), *n.* the elbow.
tupuo (K), *n.* the elbow.
turi (?) oromo turi, *n.* a creek. Cf. gauă gou.
turi (M), *n.* the middle (finger?); oto-turi (M), forefinger; turi-hia (M), the middle finger (lit. real middle: cf. ia); ete-turi (M), the third or ring finger (lit. little middle: cf. ete).
turi-oa (M), *n.* the foresail.
turiat, *prep.* in the middle, in the midst.
turihia (M), *n.* the middle finger.
turik, turika, turiko, *n.* iron; *a.* foreign (K); turiko wedere, *n.* an iron oven; turik-arubi (M), *n.* a white man. Cf. List of introduced words.
turio (K), *n.* a creeping plant; turio sirigo, *n.* a fibre made from turio. The root of this plant is sometimes eaten.

turo (K), *v.* to go.
turube (K), *n.* the centre. Cf. turi.
turuo (M), **turuturuo** (K), *n.* the throat.
turuoturuo (K), *n.* the wind pipe.
tusase (K), *n.* a plaited armlet.
tusoro (K), *v.* to squeeze.
tusuopu (K), *n.* the heart. Cf. otakapuki.
tutai (M), *n.* an armlet worn near the shoulder. The musur of Saibai.
tuto (?)
tutuopu (K), *n.* a wooden hook, used for hanging things upon.
tuture (K), *n.* the conch shell (*Fusus* or *Triton*) used as a trumpet.
tuturo, tuturu, *a.* long; tall (K); tawatawa tuturu (K), *n.* the world.
tuturuimi (KS), all. (Mir. uridili.) Cf. rorodia.
tuturuo (K), *n.* the coast. Cf. dodo, dodoro.

Ua (P), *v.* to give. Cf. uo, uosa, agiwai, nimoria.
uāā (K), *v.* to bathe.
uabogoi, *v.* to bring.
uabugoi, *v.* to guide.
uada, *a.* blessed. (Mir. werkab.)
uadi (M), *n.* the nose; uadi-muti (M), *n.* a ring worn in the nose.
uadoro, *v.* to speak good, praise.
uadow, *v.* to wonder.
uaeriivi (F), *n.* a frontlet worn by youths before initiation.
uagediai, *v.* to surround; *ad.* around.
uagi (M), *n.* the thigh; uagi-kako, *n.* the thigh bone.
uagi (F), *n.* implement used for husking coconuts made of leg bone of a cassowary.
uagori, *v.* to take.
uagoria, *v.* to look after, to care for.
uagumai, *v.* to wag the head.
uai, *a.* strong.
uaigiri, *v.* to snatch away with the intention of stealing.
uaito, *ad.* carefully; uaito uagoria, *v.* to take great care of. Mir. mamoro.
uaiuai, *a.* hard.

uapa, n. a woman's petticoat; (F), the narrow petticoat which is tucked between the legs. (D'Albertis says that this word is not used on coast at Mowat, but only in the interior.)
uapaibi (F), *n*. carved steering paddle (pl. 202, 3).
uapurĕto, *ad*. next, after.
uarabai, *v*. to help, to comfort. Mir. upinati, upiatidar.
uaramai, *a*. false.
uararai, *v*. to lose, take no heed; *a*. thoughtless. (Mir. didmirki, Saib. dantadumain.)
uaratai, *v*. to ask.
uarekabo (M), *n*. a bone spoon.
uareuo, *v*. to open.
uari, *v*. to laugh. Cf. mate.
uariu, *v*. to turn over, to turn up. Cf. uarui.
uaro (M), *n*. feathers.
uaro (F), *n* a wig worn by old men.
uaroito (M), *n*. to-morrow.
uarubia, *v*. to fly. Cf. arubia.
uarui, *v* to turn over. C. uariu.
uaruo, *v*. to receive sight. Mir. bakaerti.
uatotorope (M), *n*. the tongue.
uba, ubana, *v*. bad.
uba, ubaru (K), *n*. an edible snake, venomous.
ubagouaidumo, *v*. to defile. Cf. uba, goua.
uege, *prep*. on the bank, along-side.
uere (M), *n*. arrows.
ugaeai (K), *v*. to bark.
ui (KS), *v*. to cry out, shout.
uia, *v*. to pay back. Cf. uisa.
uiai (P), *n*. rain. Cf. uisai.
uiari (M), *n*. a shower of rain.
uibo (M), uibu (K), *n*. coal, charcoal; uibo durupi (K), *n*. an albino.
uibuna (K), *a*. light blue.
uibuuibu, *a*. black.
uisai (KS), *n*. rain. Cf. uiai.
uiui (K), *n*. a variety of mango.
umamu (K), *n*. a yam.
umiriti, *v*. to wash.

umo (M), *n.* a dog.

umoro, *v.* to know how. Mir. umele; umorotato, *v.* not to know, to be unable. Cf. karătai.

umumue, *a.* whole, entire. Mir. kemerkemer.

uo (M), *n.* night.

uo, *n,* the wind. Cf. susuo, huhua.

uo (KS), *inter.* no.

uo (K), *v.* to sleep; uo utua (K), *v.* to lie down to sleep. Cf. utua, utuo.

uomo (K), *n.* a boundary.

uoog, *n.* an animal, a bird. Cf. wowogo.

uorogomai (?), given in Savage MS. as equivalent to Mir. lem. = sun.

uosa, *v.* to give (KS), to buy (K). Cf. nimidai.

upara (K), *n.* death. Cf. paara, para, uparu.

uparu, *v.* to die; *a.* dead; poisonous (of snake), (K). Cf. para.

upi, *n.* *plur.* women; woman (K); upi baroma (K), *n.* a sow. Cf. orobo.

upuro (M), *n.* the navel. Cf. gupuro.

ura, ure (M), *n.* an island or small reef. Cf. mamoko.

ura (M), *n.* a flower. Cf. sura.

urai (?)

uramo (M), *n.* the north-west wind. Cf. suroma.

uramu (K), *n.* husband, wife, spouse.

uraoa (M), *n.* a bag.

urato, *n.* a year. Mir. urut, Saib. watö.

urio (K), *n.* a demon, ghost; the soul. Cf. manakai.

urio (? *n.* dagger); urio soro (K), *n.* a dagger made of cassowary bone.

uro (K), *n.* the sea. Cf. oro.

uroa (M), *n.* the south-east wind.

uroro, *v.* to shut partly, to shut a little way.

urouro (K), *n.* the hold or inside of a canoe.

uru, *n.* the south-east. Cf. oro, the sea, which is to the south-east of Daudai. Mir. sager.

uruapuo, *a.* out of sight, probably from the preceding word. Cf. uru, apuo, and Mir. sagerop from sager.

uruma (K), *n.* a variety of banana; (F), a head-dress worn by bush tribes in dancing and fighting (pl. 192, 3).

urumi (F), *n.* a drum (warup).

urumuruburu (F), *n.* charm in form of wooden female image, worn by young uninitiated lads (pl. 198, 1). Cf. moguru-umuru-buru, uvio-moguru.

ururu, *a.* deep.

ururudo, *prep.* at the back, behind. Mir. sor-ge.

usaro (K), *n.* a kangaroo; a dance held before a kangaroo hunt.

userio (K), *n.* a variety of yam.

usia (K), *n.* the lobe of the ear (in its natural state). Cf. atari, sia.

utua (M), *n.* to sleep; to lie down, to die (K). Cf. irorisiai, upara, para.

utuo, *v.* to sleep.

uumohoro (M), *n.* the pelvis.

uuwo, *n.* the place of departed spirits. (Supposed to be somewhere on the Fly River.)—Ann. Rep. 1894, p. 59.

uvio-moguru (F), *n.* wooden female image, used during initiation, not to be seen by women and children. Cf. oraoradubu, mimiamo, paromiti, moguru-umuru-buru, urumuruburu (pl. 195, 1).

uwere (F), *n.* bamboo pointed arrow used in killing pigs. Cf. were.

Vedasi, *n.* the pubic shell, used also as money. Ann. Rep. 1894, p. 58.

vaduru (F), waduru.

vaene (F), *n.* carved and painted dance staff (pl. 202, 6).

vedere ere (F), *n.* pubic shell worn by men when fighting and dancing (pl. 204, 4).

Wabagoii (K), *v.* to guide; wabagoii dubu, *n.* a guide.

wabi (K), *n.* a species of lizard.

waboda (K), *n.* a variety of banana.

wabutu (K), *prep.* behind.

wada (K), *n.* a bowstring, formed of "a piece of bamboo about one-fourth inch broad and half as thick."—Ann. Rep. 1890.

wada (?); irisai wada (K), *n.* enemy.

wadai (M), *n.* red flat seeds.

wade (K), *a.* beautiful, fine, good; wade topo obo, *n.* drinking water; wade odio, *a.* edible; wade sai, *n.* fine day.

wadere (M), *a.* good. Cf. wade, adina.

wadisia (K), *n.* a hole in the septum nasi. Cf. wodi, sia.

wadoa (K), the pepper eaten with betel nut.
waduru (K), the native bamboo tobacco-pipe (pl. 188, 2).
waea (K), *n.* the hornbill. Cf. orkienkok.
wagi (K), *n.* the thigh.
waia (K), *v.* to warn.
waiati (K), *n.* a water melon.
wairi (M) *ad.* forward (for'ard). (? whether this is not the Motu vaira, face, front; vaira lao, to go forward.)
wakaru (Domori), *n.* bag in which dress of all kinds is held (pl. 191, 1).
wameai (?) nitara wămĕai (K) *v.* to return.
wami (M),
wanogoro (K), *n.* a coral reef.
waopo aibi (K), *v.* to steer. Cf. aibi.
wap, *n.* a dugong spear. Cf. Saibai.
wapa (K), *n.* a petticoat.
waperbi (M), *v.* to come aft and steer. Cf. waopo aibi.
wapu (M), wapu oa (M), *n.* the mainsail of a canoe.
warame (K), *n.* deceit, falsehood, "gammon"; warame dubu, *n.* a liar. Cf. mabu.
waraoit,
waratai (K), *v.* to answer, reply. Cf. gibo.
waratoto (K), *n.* a bridge.
warea (K), *n.* a venomous snake.
wari, *v.* to laugh, smile; wari patu (M), *v.* to laugh greatly. Cf. kiri.
warikabi (K), *n.* a stone axe.
wariu (K), *n.* a hawk.
waro (M), *n.* rope; perhaps introdueed. Cf. Motu, varo, Kerepunu, waro, Sinaugolo, walo.
waromi (K), *v.* to dwell.
waroti (K), *v.* to wash.
warŭbai (K), *n.* a load.
waruku (K), *n.* an edible snake, said not to bite.
wasare (K), *n.* a hymn; wasare boso, *n.* or *v.* whistle. Cf. poho.
wasi (?) wasi nakobokobo (K), *a.* lazy. Cf. oiwoĭi.
watatorope (K), *n.* the tongue.
wateripi (M), *n.* the tongue.
waupi (?)

waŭpo (K), *v.* to make, prepare.

wedere (K), *n.* a large slipper shell (*Cymbium*) said to be imported from Mowat; hence, *n.* a basin, bowl, clay cooking pot, saucepan; turiko wedere, *n.* an iron oven.

wera (M), *n.* speech, talk. Cf. auera, ouera.

were (M). *n.* clay.

were (M), *n.* an arrow; (F) a bamboo beheading knife.

weri (M), *n.* a bamboo knife.

weri (K), *n.* leaves of palm for thatching roof; a roof; weri adoruti, weri adorowa, *v.* to make a roof.

wibu, *a.* black; wibu arubi (M), *n.* a black man. Cf. uibi.

wiĕri (M), *n.* rain.

wieri (M), *n.* sandy beach. Cf. wio.

wihari, *n.* rain. The overflow from the rivers and swamps of Aromo.

wio (K), *n.* sand, the beach, a sand bar.

wiora (M), *v.* to hoist up.

wiroguri (K), *v.* he comes.

wiroro (K), *v.* to call. Cf. irumai, koromai.

wisa (K), *n.* payment; wisa oosa, *v.* to pay.

wiwi, *n.* the mango.

wodi, *n.* the nose.

wogati (K), *v.* to do. Cf. auagati.

woito (K), *n.* or *v.* dream.

woka (F), *n.* a small dish for holding food and sometimes used as pillow (pl. 193, 3).

wŏpa (M), *n.* a large petticoat. Cf. wapa.

woperbi (M), *v.* to steer.

woroworo (K), *n.* anger.

woto (?)

wowogo, *n.* a bird; wowogo moto (K), *n.* a bird cage; wowogo toto (K), *n.* a nest.

wowogo ia (K), *n.* a white crane (lit. real bird); wowogo ia maru ma, a sooty crane with white neck.

Zoke (M), *n.* a dagger made of cassowary bone. (Written tsoche by D'Albertis.)

zugu, *a.* tabu, holy. Mir. zogo.

XIV.—List of Introduced and Adapted Words.

In this list all words not otherwise marked are derived from the English, and are commonly used in both Miriam and Saibai. M denotes that the word is used in Miriam, S in Saibai, D in Daudai, M in Mowat, K in Kiwai.

Ad (M), God, a deity.
alabasa, alabaster.
alas (M), *alase* (S), salt. Lifu *alase* from Greek ἅλς. [Alase-nu (S), in salt; alasiu ter (S), flavour of salt, saltness; alasilgal (S), salt people.]
angela, angel.
ao (S), a tomb, lit. a pit.
aper (M), a hat.
apiga (S), the Malay apple, *Eugenia sp.* Probably introduced with the fruit from the Melanesian islands. Fiji *kavika*; Banks' Islands *gaviga*; Efate *kafika*; Malekula *havih*; Santo *aviga*.
aposelo (S), *apostola*, apostle.
aramoberi (K), God, sky-man.
arem (M), heaven, lit. sky.
arenio, lamb. Greek ἀρνός.
areto, bread, loaf, sacrament. Greek, ἄρτος.
aromo (M), heaven, lit. sky.
asina, ass. Lifu, *asina*, Latin ăsĭna. [asinau, asinan (S).]
Augadö (S), God. This appears to be the same word as *Augŭd*, a totem.
azazi (S). This word probably means 'travelling.' *Azazi-san*, (travelling foot), shoe, sandal; *azazi-mabaeg* (travelling-man), traveller, guest.

Bao = *bau*.
bapataiso, to baptize, baptism.
baroma, a pig. Probably introduced with the animal from New Guinea. Motu, *baroma*.
baselaia, kingdom. Greek, βăσῐλεία. [Baselaiapa (S).]
bathi (M), a measure. Lifu *bathe* from English *bath*. ("Bath" was used to translate the English "firkin" as being approximately the same measure.—Rev. J. Sleigh).
bau (M), chair, lit. seat; *bau-lu*, a table.

boks, box.

bōgailbōgail (s), cursing and swearing. Mk. xiv. 10. (?), plur. of bögai, from Eng. slang term.

boonarri. This word is given by Jukes for "*coconut*," and is the native pronunciation of "bow and arrow." When ships first visited the islands these were common articles of trade. The natives may have known that "*boonarri*" signified the weapons, or they may have thought that it was the English for "*coconut.*" It is certainly not a Torres Strait word.

borom = *baroma*.

buket, bucket.

burum = *baroma*.

but, boot.

Dana-nuki (s), a spring of water. This is a curious word given in Sharon's vocabulary, and literally means *eye-water*. It corresponds literally to the Samoan *mata-vai*, also meaning a spring of water. *Dana* = *mata*, eye, *nuki* = *vai*, water. The Lifu word for spring is *qeqe* (pronounced *whewhe*).

dapar (s), heaven, lit. sky.

debe merkem (M), the Gospel, lit. *debe*, 'good,' *merkem*, 'speech' or 'message.'

demoni (s), demon, devil; *demonilgōpa*, to one possessed.

dia, a club, imitated from a Lifu model. Lifu *jia* (pronounced *dhia*).

diabolo, devil. Greek διάβολος.

diakona, deacon.

dibedib, a dish, lit. a sp. of shell. Cf. *dibidibi* in Vocabs.

Disēmba, December.

Eden, Eden.

eit, eight.

ekalesia, church. Greek ἐκκλησία.

elefen, eleven.

Ellene, a Greek. Greek Ἕλλην.

erurwur (M), to smoke a tobacco pipe in native fashion, lit. to drink heat.

esorapa (M), to pray, lit. sit with bended head.

esorgiru (M), to pray, lit. to bow the head in worship.

etage (M), to read, lit. to point to, to count.

etheni (s), heathen; *ethenlgōpa*, to the heathen.
etkobei (M), to bury, lit. to lay a corpse *on* not *in* the ground.
euangelia (M), *evangelia* (s), Gospel. Greek *εὐαγγέλιον*.
eser, a dish, lit. Cymbium shell.

Faiboibo, marriage. Lifu *faiboibo*; Samoan *fa'aipoipo*. This was a Rarotongan word, *akaipoipo*, introduced into Samoa for a "marriage with a religious service." From Samoa it was taken to Lifu and thence to the Straits. *Fa*, *fa'a*, *aka* is the Polynesian causative prefix, *ipo* has reference to loving. Tahit. *ipo*, a darling. Haw. *ipo*, a sweetheart, paramour; Gambier Isd. *ipo*, married.
faif, five.
falaua, *flaua*, flour.
farthen, farthing.
faul, fowl.
Februari, February.
fifete, fifty.
fiva, fever.
foa, four.
foati, forty.

Gavana, governor. [gavanalpa, (s).]
gem-wali (M), shirt, chemise, lit. body-cloth.
gena, hell. [genapa (s).] Heb. Gehenna. Samoan, *kena*, Lifu, *gena*.
geru (s), sugar cane. Cf. Hayter Islands and South Cape *garu*.
getidiz, *getō-tidiz* (s), to read, lit. to put out the finger, to point.
giz-mer (M), sermon, lit. many words.
glas, glass.
gold, gold.
government.
grin, green.

Handed, hundred.
hanuaboi (K), night. This word is only found in MacGregor's Kiwai list, and is perhaps due to a Motu interpreter. It is the Motu word for night and is, literally, *hanua*, country; *boi*, dark, the common Melanesian words *vanua* and *bongi*.
haua, *hawa*, hour,

Hebru, Hebrew.
Hedis, Hades, hell. Greek ᾅδης.
hook, hook.

Idolu (M), money, lit. precious thing.
Isaraela, Israel; Isaraela lögau kuikulunga, the king of Israelites.

Januari, January.
jauali (M, D), paper, letter, book. A Miriam word with an introduced meaning, and should properly be spelled *siauwali*. *Ziau* is the dura-mater, the parchment-like membrane covering the brain, *wali* is calico or cloth, especially European cloth.
Judaia-le (M), Jew.
Julai, July.
Jun, June.

Kaikai, food, a meal. This word is in use all over the South Seas, and is derived from the Polynesian *kai*.
kaip, a spoon, lit. a shell; *kaip tulik*, an iron spoon.
kamela, camel.
kapsize, capsize.
kask, cask.
kat, cat.
kau, cow; *kimiar kau* (M), bull, lit. male cow; *kaura paur* (M), leather, cow's skin.
kenturio, centurion. Greek κεντυρίων. [keneturialngu (S).]
ki, key.
kiona, snow. Greek χιών.
klok, clock.
kobar, vessel, cup, dish. Probably from English copper.
kohena, priest. Heb. כֹּהֵן
kon, corn.
kopa, dried coconut, the *copra* of commerce.
kŏpamauri, the earth-oven (properly *ame* (M) *ămai* (S)). This word is as widely spread in the South Seas as *kaikai*. Dr. Codrington informs us that it is compounded of *kopa* = English "*copper*" and *mauri* = *maori*, i.e. a native of New Zealand. Hence it is the maori's copper, a term used by whalers, traders, etc., to designate the native method of cooking.

kot, coat.

kot meta (M), court-house, judgment hall. [kot-em, to the court.]

kotor (M), heaven, lit. above.

kumala, sweet potato (*Ipomaea chrysorrhiza*). Lifu *kumala* from Samoan '*umala*. Pratt in his Samoan Dictionary says it is an introduced word. The word is widely used in the Pacific. Tongan *gumala*; Marquesas, *kumaa*; Banks Is., Fiji and Maori, *kumara*.

kumete, basket. Lifu *kumete* from Samoan '*umete*, a wooden bowl.

kunu (K), maize. English, *corn*.

Lamar (M), demon, devil, lit. *le*, man, *mar* spirit.

lamepa, lamp.

laulau, table. Lifu *laulau* from Samoan *laulau*, a tray made of plaited coconut leaf.

le neg (M), reapers, lit. men (of) seeds. Cf. *meta-neg*.

lepera, leper.

leuen, *levene*, leaven.

lino (S), linen.

lino-wali (M), linen. English and Miriam.

luko, wolf. Greek λύκος.

lukup (M), medicine, paint. Perhaps from Miriam *lu* and Saibai *kupe*, a medicinal plant.

Malil, an iron plate, a sheet of metal; *malil-lager* (M), a chain. Perhaps from Lifu *melele*, thin.

mamoe, sheep. Lifu and Samoan *mamoe*. Introduced into Samoa from Tahiti and also used in Rarotonga.

mamus, chief. A Miriam word introduced into Saibai and Daudai. It seems to have originally been a personal name, *Mam-mus*, Red-hair, but is now applied to the native placed in authority on each island by the Queensland government.

manakai (D), soul, ghost. Cf. Malakai in Saibai vocab.

mani, money. [maniu, maniginga (S).]

map, map.

maram-gudō (S), a tomb, lit. a pit with mouth.

maridan (S), mirror, looking-glass, lit. spirit-eye, i.e. by which one sees the spirit or reflection of anything.

Mark, March.
masita, master.
Mei, May.
mei, an anniversary, a festival. The term is taken from the annual gatherings in London known as "May-meetings." In the Straits "mays" have no reference to the time of year, but simply denote the annual examinations, sports, etc., at the mission schools and stations.
mer-akesmu (M), oath, swearing, lit. fall down word.
meta-neg, a barn, lit. house (of) seed. Cf. le-neg.
minarpalai (S), write, writing, lit. *minar*, mark, *palai*, cutting; *minarpalai mabaeg* (S), a writer, scribe.
minuta, minute.
misinare, missionary.
mog-wali (M), towel, lit. bit (of) cloth.
Monde, Monday.
monki, monkey.
muro, myrrh. Greek *μύρον*.

Na, hymn, lit. song.
nain, nine.
naipo, knife.
nani, goat. English, *nanny*.
nĕrkĕp (M), the mind, heart, soul, lit. *kĕp*, seed, *nĕr*, breath.
net, net.
ngönakapö (S), mind, heart, soul, lit. *kapö*, seed, *ngöna*, breath.
nidel, needle.
nog-le (M), heathen, lit. outside men.
Novemba, November.
numela, number.

Oktoba, October.
osua (K), heaven, lit. sky.
ou (P), heaven, lit. sky.

Paip, pipe.
pama, palm-tree.
pasaro (D), hill, from Miriam *paser*.

paseka, passover. Greek πάσχα. [pasekapa (s).]

pat, bell. Lifu *pate; pat ipit* (M), to ring a bell. The Lifu *pate* is a piece of wood hollowed out like a canoe, and struck with one or more sticks. The Miriam *ipit* is "strike."

paun, pound.

păŭoro (M), gunpowder. English *powder*.

peleit (s), plate, dish.

pen, pen.

peni, penny.

pensil, pencil.

pentekosta, Pentecost. Greek πεντηκοστός.

pĕripĕr (M), mirror, looking-glass. A Miriam word with introduced meaning, lit. lightning.

peritom, circumcision. Greek περιτομή.

perofeta, prophet.

pes, candlestick. The proper meaning is "handle."

pi (M), gunpowder, lit. wood ashes.

podo (D), hill, from Saibai *pada*.

pöi (s), gunpowder, lit. ashes.

polisman, policeman. In the Miriam Gospel, Mark, xv. 16, this word is curiously used for "soldier." *Gair polisman Iesu kebi meta-em tegared, nei Praitorio, a polisman nosik taraisare*, Policemen Jesus little house-to took, name Praetorium, and policeman-band called together.

pusa, cat. English, puss.

Rabi, rabbi.

Ring, ring.

Sabath, sabbath. [sabathau, sabathini, and sabathipa (s).]

sagul (s), school, *v.* to examine.

saima (s) = *sarima*.

salmo, psalm.

sarima (D, s), outrigger float. Probably from Hayter Island, *sarime*, Motu, *darima*.

Satana, Satan. *Satanara uteb* (M), hell, lit. Satan's abode.

satauro, cross. Greek σταυρός; *satauroem* (M), to crucify. [sataurompa, sataurangu (s).]

sefen, seven.

Septemba, September.
setadia, furlong. Greek σταδιον.
shippo, ship.
sikĕs, six.
sinapi, mustard. Greek σίνᾶπι.
sok, a nail, really a spike made of cassowary bone; *sok tulik*, an iron nail.
sokop, *sukub*, *sukuba*, etc., tobacco.
sor tulik, a cup, lit. iron shell.
spun, spoon.
stor, a store, shop.
suke, fig, figtree. Greek σῦκον. [sukeu, (s).]
sunag, *sunagog*, synagogue. Greek συνᾶγωγή.

Tabo kaukau, a trade necklace of beads, from *tabo*, neck, *kaubkaub*, balls.
taim, time.
talani, talent.
talofa, *talopa*, to greet, to shake hands (an introduced custom). Samoan *tālofa* for *ta alofa*, the ordinary salutation, from *alofa*, to love, compassionate.
tanelu (M), a dish, plate, basin. Samoan *tānoa*, a dish or plate, and Miriam *lu*, thing.
taual, towel.
teibur-tulik (M), a sword, lit. pith-iron, *i.e.*, the iron which is inside a sheath, like pith in wood.
telona, a publican, taxgather. Greek τελώνης.
ten, ten.
teriko-gagari (S, D), gun, musket, to shoot with a gun. English *trigger*, and *gagari*, to shoot.
thausan, thousand.
therte, *thörte*, thirty.
thri, three.
Thursde, Thursday.
tik-a-tik, a watch.
titi (D), to write, lit. paint.
tŏmahauk, axe. English, tomahawk.
triger-gagari, a gun, lit. "trigger bow and arrow."

tu, two.

tuelf, twelve.

tuente, twenty.

tuli, *tulik*, *turik*, iron. Crawford (Grammar and Dictionary of the Malay language, p. clxxv.) says that *tuli*, *tudi*, *turi* is probably the English word "tool."

turik-arubi (D), a white man. From *turik*, iron, *arubi*, man.

Tusde, Tuesday.

tusi (S), book. Samoan *tusi*, lit. to mark native cloth, hence writing, letter, book. Introduced into Lifu from Samoa.

Umau-lagö (S), tomb, lit. *lagö*, house, *umau*, of the dead.

Vina, wine.

vinega, vinegar,

Waci, watch. This is the English word spelled in Lifu fashion, *c* = *ch* in chin.

waina, wine, vine.

wali, European cloth or calico; *wali demed*, a curtain or veil, lit. shutting cloth.

wan, one.

Wensde, Wednesday.

werkab (M), happy, blessed. Perhaps from *wer*, appetite in sense of desiring, wishing, *kab*, to dance.

wik, week.

Zogo, holy, lit. a charm or fetish; *zogo-jiauwali*, Holy Scripture; *zogo-le*, a priest; *zogo meta*, a church.

When the introduced word differs in pronunciation from its English original, such as *numela*, *masita*, the alteration is due to Lifu influence, as the natives of Torres Straits have no difficulty in correctly pronouncing such words as *number* or *master*. Lifu and Samoan require every consonant to be followed by a vowel, and hence the modification of the English and Greek words introduced by the Lifuan teachers.

In the detection and derivation of Lifu words we have derived much assistance from the Rev. J. Sleigh, for many years resident on Lifu.

XV.—Concluding Remarks.

(A) *Bibliography.*

The following additions have to be noted:—

(27) (*n. d.*) Hymn Book.—Saibai.

[Mentioned by D'Albertis, New Guinea, p. 350.]

(28) 1880. D'Albertis, Luigi Maria.—Alla Nuova Guinea: ciò che ho veduto e ciò che ho fatto. Torino, Londra. 8°. pp. xvi and 588.

[Contains: p. 567. Vocaboli usati nell' Isole York, Torres Straits, p. 568. Vocaboli usati dalla gente di Moatta, alla foce del Fiume Katau.] For English Version, see No. 9.

(29) 1883. New Guinea Numerals. Letters by Messrs. A. H. Sayce, Krebs, A. H. Keane, and Coutts Trotter. In Academy, vol. xxiv. (1883) pp. 285, 302, 317.

On p. 317, a letter by Mr. Coutts Trotter contains the Saibai numerals.

(30) 1892. Queensland.—Annual Report on British New Guinea, from 1st July, 1890, to 30th June, 1891, with Appendices. Brisbane: By authority, James C. Beal, Government Printer, William-street.

Contains, among other vocabularies: pp. 128–132, "Aboriginal Vocabulary of the Dabu tribe. Table showing certain principal words, &c., used by aboriginals of the Dabu tribe, and more or less understood by other tribes between Mowatta and the Mai Kussa, on the coast of British New Guinea. (Some words have been taken from the neighbouring Toga tribe, when the two dialects differ.)
This vocabulary is discussed in the next section.

(31) 1892. Thomson, J. P., F.R.G.S.—British New Guinea. London: George Philip and Son.

An Appendix.—"VI. New Guinea Dialects," contains: pp. 286–292, Vocabulary of the Kiwai Language; pp. 292–294, Vocabulary of the Language spoken at Saibai, Dauan, and Boigu, and understood on the adjacent coast of New Guinea; also, on pp. 320–322, Aboriginal Vocabulary of the Dabu Tribe. The Kiwai and Saibai vocabularies are from the Annual Report on New Guinea, 1890 (See Bibliography in Part I. of this study, No. 23, p. 470), and the Dabu from No. 30, above. There is nothing original in this book.

(32) 1892. Schulenburg, Dr. A. Graf v. d.—Grammatik, Vocabularium und Sprachproben der Sprache von Murray Island. Leipzig: Verlag von Wilhelm Friedrich, K. R. Hofbuchhändler.

The whole of this work is founded upon the two Miriam Gospels (see No. 13 in Part I., p. 469). No reference is made to any other sources of information.

(33) 1893. Haddon, Prof. A. C.—"The Secular and Ceremonial Dances of the Torres Straits," in Internationales Archiv für Ethnographie. Bd. vi. 1893, pp. 131–162.

Contains, on p. 148, the Waiitutu Kap Kudu, or couplets of the saw-fish dance of Thursday Island, with a note on New Guinea songs.

(34) 1893. Ray, Sidney H.—"The Languages of British New Guinea," in Transactions of the Ninth International Congress of Orientalists, held in London in 1892, vol. ii. pp. 754–770.

This contains a suggested division of the dialects of British New Guinea into Melanesian and Papuan, with a classification. On pp. 760–762 the Miriam, Saibai, Dabu, and Kiwai pronouns are compared with those of other dialects. An Appendix contains twenty-five words and Numerals in the Torres Straits and other New Guinea dialects.

(35) 1893. Kern, Dr. H.—Review of the "Study of the Languages of Torres Straits. Part I." Contained in Internationales Archiv für Ethnographie." Bd. vi. p. 181.

Dr. Kern points out that more stress is to be laid on the construction than on the vocabulary, when determining the relationship to other languages. We fully appreciate this.

(36) 1894. Ray, Sidney H.—"The Languages of British New Guinea," Journal of Anthropological Institute, vol. xxiv., pp. 15–39.

An amplification of No. 34, *antea*.

(37) 1894. Queensland.—Annual Report on British New Guinea, from 1st July, 1892, to 30th June, 1893; with Appendices. Brisbane: By authority, Edmund Gregory, Government Printer, William-street. 1894.

Contains:

Appendix I.—Report of the Resident Magistrate for the Western Division.

Appendix P.—Native Habits and Customs in the Western Division, by B. A. Hely, Resident Magistrate.

Appendix U.—Nos. 1–4, Land Tenure of the Tribes of the Daudai Coast, by J. B. Cameron and B. A. Hely.

These Appendices contain numerous words and names used in the Daudai district. They have been added in XIII. and XIV. of this Study.

(38) 1894. QUEENSLAND.—Annual Report on British New Guinea, from 1st July, 1893, to 30th June, 1894, with Appendices. Brisbane: By Authority, Edmund Gregory, Government Printer, William-street. 1894.

Contains: pp. 50–55, Appendix L, Report of the Resident Magistrate for the Western Division.
[Contains native names.]

(39) 1895. RAY, SIDNEY H.—A Comparative Vocabulary of the Dialects of British New Guinea, with Preface by Dr. R. N. Cust. London: Society for Promoting Christian Knowledge, Northumberland-avenue, W.C.

A comparison of fifty-two British New Guinea Dialects, including the Kauralaig, Saibai, Dabu, Mowat, Kiwai, and Miriam of Torres Straits and the adjacent coasts of New Guinea.

MS. 11. FISON, REV. LORIMER FISON.—Saibai compared with Nineteen New Guinea Dialects in twelve words of common use (pp. 2–3).

Words common to Saibai and Kaurarega, pp. 4–6; words common to Kaurarega and Gudang, pp. 6, 7; pronouns, p. 8.

[The examples are taken from Macgillivray and the Saibai Gospel.]

B. CONNEXION OF THE LANGUAGES.

The publication of a vocabulary of the language used by the Dabulai and Togalai people on the mainland opposite Saibai Island (contained in the Annual Report, 1892, Bibliog. No. 30), is of some assistance in indicating the relationship of the islanders of the Straits to those of the mainland. Sir Wm. MacGregor points out (Rep. p. 43) the great difference which exists between this language and those of Kiwai and Saibai. Some Saibai words in the Dabu vocabulary are no doubt owing to the Saibai language being the means through which the words were obtained. It is very remarkable, however, that there are numerous agreements between the Dabu and

the Miriam, which are not exclusively confined to trade words, and can hardly be due to a recent contact of the peoples. The following lists will exhibit the connexion of the four languages, Dabu, Miriam, Saibai, Daudai:—

ENGLISH.	DABU.	MIRIAM.	SAIBAI.	DAUDAI.
bead,	kusa,	kus,	kusa,	kusa.
cassowary,	diram,	sam,	samu,	samo.
father,	baba,	baba,	baba,	aba.
Kangaroo,	tar,	usar,	usa,	usaro.
seed,	kapa-biu,	kep,	kapu,	iopu.
snake,	dibe,	tabo,	tabu,	topo.
tobacco,	sakaba,	sokop,	suguba,	sukuba.
yes,	ao,	wao,	wa,	io.

ENGLISH.	DABU.	MIRIAM.	SAIBAI.
bay,	kopa,	kop,	kupadö.
boat,	gara,	nar,	gul.
crocodile,	kaja, koje,	kadal,	Kadal.
drüm,	arap,	warup,	warup.
flea,	totok,	titig.	tikat.
flesh,	mid,	med,	madu.
knife,	turik-ata,	kor-tulik,	gi-tulik.
game (*play*),	tongoi,	segur,	sagul.
gum,	tauto,	sus,	susu.
jaw,	tebu,	ibu,	ibu.
matches,	guigui,	goigoi (*fire-stick*,),	guigui (*fire-stick*).
paddle,	kaba, *n.*	ireb, *v.*,	kaba, karaba, *n.*
peace,	piuda,	paud,	pautö.
shark,	baidamo,	bezam,	baidamö.
pipe,	turku,	tarkok (*pipe-bowl*),	turku (*pipe-bowl*).
rat,	makat,	mokeis,	makas.
sago,	bisi,	bisi,	bisi.
vomit,	maunjeje,	megi,	magiz.

ENGLISH.	DABU.	MIRIAM.	DAUDAI.
beach,	dardar,	dodo-mer,	dodo.
coconut,	ngoi,	ue,	oi.
hand,	tang,	tag,	tuo.
knot,	mukup,	mukub,	mopo.
plenty,	uog,	au,	auo.
shoulder,	dago-kut,	tugar,	tigiri,
snore,	gararam,	gegermer,	gărŏroă.

ENGLISH.	DABU.	SAIBAI.	DAUDAI.
ditch,	gorai,	goua,	goua.
fish-hook,	tudi,	tudi,	tudi.
reef,	maja,	mazam,	maja.
sneeze,	achi,	asio,	asoro.

ENGLISH.	DABU.	MIRIAM.	ENGLISH.	DABU.	MIRIAM.
banana,	opa, wo,	kaba.	husband,	gnumua,	kimiar.
beetle,	seresere,	isiri.	nipple,	nono,	nano.
belly,	kom, kam,	gĕm, kĕm.	palm (*hand*),	dhag,	tag-gab.
blood,	mem, mam,	mam.	red,	mamam,	mamam.
breast,	gnam,	nano.	salt,	gagör,	gur (*salt water*).
eyeball,	ikapa,	irkĕp.			
fly,	arko,	narger.	smoke,	imo,	kemur.
foot,	mak,	mek (*foot-print*.	star,	piro,	wer.
			water,	ine,	ni.
friend,	tabad,	tĕbud.			
heaven,	utali,	kotor.			

ENGLISH.	DABU.	SAIBAI.	ENGLISH.	DABU.	SAIBAI.
ask,	mulagan,	mulai (*speak*).	necklace,	amuta,	kamadö.
basket,	enyaunga,	iana.	oyster,	it,	ita, itro.
bid,	muleige,	mulai (*speak*).	pole,	sur,	surö.
bite,	dangdang,	dang (*tooth*).	reed,	böch,	buzö.
black (*dark*),	kuta, dabar,	kuta-pa (*evening*).	salt water,	adabour,	adabu.
			sand,	chirum,	surum.
call,	mule,	mulai (*speak*).	sea,	bäu,	bau.
cloud (*dark*),	dabar-dag,	dapar (*sky*).	shrimp,	guiji,	gagi.
come,	wia,	aie, boie.	south east,	wura,	waura.
flog,	metamar,	mataman.	turtle,	waru,	waru.
God,	augad,	augadö.			
hasten,	taramani,	tarai (*quick*).			

ENGLISH.	DABU.	DAUDAI.	ENGLISH.	DABU.	DAUDAI.
demon,	kabor,	oboro.	ulcer,	ute,	ioto.
man,	rabu,	dubu.	wood,	ro,	soro.

These comparisons and those in Pt. I., pp. 505–507, show that the island languages (Miriam and Saibai) are more alike than those of the mainland (Daudai and Dabu). They also show that Miriam is more

like the mainland languages taken together, than it is like the Saibai, and that Miriam is more like Daudai than the Saibai. The correspondences between the island languages and the Dabu are equal. These results may be tabulated thus:—

	MIRIAM.	SAIBAI.	DAUDAI.	DABU.
MIRIAM, .	..	109	94	51
SAIBAI, .	109	..	25	51
DAUDAI, .	94	25	..	19
DABU, .	51	51	19	..

Other Papuan vocabularies published in the Reports, 1892–1894, are those of: (1) Domara and Mairu (central portion of South Coast of New Guinea and Island of Mairu); (2) Toaripi (the same as the Motumotu); (3) Orokolo (nearly the same as the Toaripi); (4) Maipua (on the Purari Delta). These show no correspondences (beyond those in Pt. I., p. 509) with the Torres Straits or Daudai languages.

The distinction between Melanesian and Papuan first indicated in the first part of this study, has been more fully illustrated as to language in the Journal of the Anthropological Institute (1894), and in the "Decorative Art of British New Guinea"—Cunningham Memoirs, Royal Irish Academy, 1894. It has been adopted by Mr. A. H. Keane in his work on "Ethnology," Cambridge, 1896; and is further confirmed by the existence in German New Guinea of non-Melanesian dialects.[1] In the Katedong or Bush language in the Hinterland of Finschhafen, nouns and pronouns are declined as in Miriam. The verb has complicated forms:—

Indefinite case,	*mama*, father,	*nengo*, mother,	*maleng*, earth.
Case of author,	*mama-dsi*,	*nengo-dsi*,	*maleng-dsi*.
Final,	*mama-te*,	*nengo-te*,	*maleng-te*.
Locative,	*mama-he*,	*nengo-he*,	*maleng-go*.
Vocative,	*mama-mai*,	*nengo-mai*,	
Praedicative,	*mama-tine*,	*nengo-tine*,	

[1] See Zeitschrift für afrikanische und oceanische Sprachen, I. Jahrgang. 1 Heft., 1895, p. 83. Ein Beitrag zur Kenntniss der Kai-Dialekte auf Grund des von Herrn Missionar Joh. Fliert in Simbang gesammelten Materials bearbeitet von W. Grübe.

The Katedong numerals are *mo*, one; *jejahe* (pronounced yeyahe), combined as in Miriam, *jahe a mo*, three; *jahe a jahe*, four; *me mo* (one hand), five.

C. MIRIAM GRAMMAR.

The Murray Island Grammar of Dr. A. Graf. v. d. Schulenberg (Bibliog. No. 32) is based on the translation of the Miriam Gospels (No. 13), which formed part of the material for our grammar in Part I. Dr. Schulenberg makes no reference to other sources of information, although a vocabulary and notes on the language were published by his relative, v. d. Gabelentz, in 1882 (No. 11). The omission, no doubt, arose from the translation being styled "Murray Island Language," whilst the vocabulary (based upon Jukes, Macgillivray, and Stone) is called the language of Errūb and Maer.

Dr. Schulenberg's work is thus arranged:—

(*a*) Grammatik,	I. Laut- und Betonungslehre,	pp.	1–2.
	II. Der Sprachbau, . .	,,	3–6.
	III. Wort- u. Formenbildung,.	,,	7–58.
	IV. Hilfswörter, . . .	,,	59–67.
	V. Zum Satzbau, . . .	,,	68–77.
(*b*) Vocabularium, ...		,,	79–114.
Lehnwörterverzeichnis, . . .		,,	115–116.
(*c*) Sprachproben, ...		,,	117–133.

Considering the faulty character of the translation used, and the absence of outside information, Dr. Schulenberg has made a fair attempt to elucidate the forms of Miriam Grammar, but it is manifest that when the soi-disant translators of the Gospel express themselves ignorant of the grammar, we cannot expect an entire absence of error from the work of those who attempt to analyse their productions. It will be convenient here to give a summary of Dr. Schulenberg's Grammatical forms for comparison with our grammar in Part I.:—

1. *Nouns.*—Case endings: Possessive, *r*, *ra*; Dative, *im*; Illative, *em*; Ablative, or Elative, *lam*; Causal and Instrumental, *de*; a second Instrumental, *u*; Locative, *ge*; Emphatic Article, with Proper names, *et*; probable accusative (obsolete), ending *i*.

   Plural by *gair*, *gaire*, *gai* or *giz*. Plural prefix *u* in *ugab*, *uader*, *uridili*.

2. *Adjectives.*—Same as R and H. Pt. I., p. 534.
3. *Numerals.*—*Neisiem* and *neisem* are noted, but they are not shown as causative.
4. *Pronouns.*—As in R and H. Pt. I., p. 527. The word *dali* is called a verb, and translated thus:—

kaka nali, ich bin es. *darali*, zwei (beide) sind, waren.
mama nali, du bist es. *idali*, } hier, dort, sein.
e dali, er ist es. *pedala*, }

Other forms given are *uadali*, *iamdali*, *iadali*, *edali*.

VERBS: *Prefixes.*

de, causative.
di, causative or directive outward.
da, directive thither.
e, emphasises author of the action, when action goes out to the third person.
a, gives negative character to the sentence.
a, in positive sentence only with *tager*, is reciprocal.
dara, plural, and summarises.
na, uncertainty and futurity.
ba, expresses a mournful or sometimes excited condition of the mind.
te, motion thither or hither.
tara, instead of *te* in sentences which indicate completed action.
i, conditional or accidental.
o, direction from before, or from above.
io, only in word *iobaru*, position before.
ua, direction from above.
ia, only in *iauataba* and *iadali* has demonstrative meaning.
ao, on, on upper side, above or high.
esa, (?)
oga, (?)
oka, (?)
uë(*e*), *ue*(*e*), on upper side.

Suffixes.

er, *ar*, *ir*, *or*, *ur*, no special meaning.
em, corresponds with noun ending for accusative.
l(*am*), corresponds to ending for ablative.
iam (?)
lu, perfect, the realization of an expectation.
li, perfect and continued action.
i, nearly same as *li*.
(*l*)*ei*, action goes out to two persons.
(*r*)*ti*, perfect.
are, plural subject.
ruk, action from below.
rik, up, thither.
ot, into.
meida, down.
eder, participal meaning.
ua, *oa*, out down.
le, mankind.
ao, action in solemn or serious fashion.
u, (?)
o, probably same as prefix *o*.
os, doubtful.

Most of these meanings are conjectural. Hence, as we have stated in Part I., much is yet to be done in the study of the Miriam verb.

As Dr. Schulenberg was unacquainted with the Lifu origin of his translation he has not distinguished loan words from Lifu, and Samoan from the native words. In his Lehnwörterverzeichniss, the word *ares*, said to be Greek, is native, *kotem* is derived from the English *court*, not from *cot* or *cottage*. *Telona* is Greek.

Concerning the relationship of the languages, Dr. Schulenberg has only the following note:—"An das Malayische erinnern mehr oder minder entfernt die Personalpronomina: ka = ich, ma = du, e = er. Murray t statt mal . s konnte man finden in (de) taut: sāhut = antworden, (ne-)tat: suātu, sātu = eins, (ne-)te: alifuru sei = wer?"

In bringing to a close this Study of Languages, which are probably destined to pass away before the advance of civilization in New Guinea,[1] the authors would express their obligations and thanks to all who have aided in bringing it to a successful conclusion, especially to the generous friend who gave the sum of £30 to enable the Academy to print the Second Part of this Study; we regret that his modesty will not permit us to record his name. Any further information on the languages, verification or corrections of the grammar notes, would be welcomed by the authors, at the Anthropological Institute, 3, Hanover-square, London.

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[1] According to Rev. J. Chalmers (Globus, LXII. 21, p. 336), the population of Torres Straits in 1893 was only 1473, distributed as follows:—Saibai, 242; York Is., 95; Dalrymple, 62; Stephen, 26; Darnley, 137; Murray, 340; Mabuiag, 195; Badu, 124; Moa, 92; Tauan, 30; Boigu, 130.

IX.

VECTOR EXPRESSIONS FOR CURVES. By CHARLES JASPER JOLY, M.A., F.T.C.D.

Part I.—Unicursal Curves.

[Read December 14, 1896.]

1. *Vector equation for a unicursal curve of the n^{th} degree.*

Let $a_0, a_1, a_2 \ldots a_n$ be any given and constant vectors, and $a_0, a_1, a_2 \ldots a_n$ be given scalars; then the general vector expression for a unicursal curve of order n may be written in the form

$$\rho = \frac{a_0 t^n + n a_1 t^{n-1} + \ldots + a_n}{a_0 t^n + n a_1 t^{n-1} + \ldots + a_n},$$

in which t is a variable scalar parameter, and ρ is the vector to a point on the curve. For, consider the number of points on this curve locus which lie in an arbitrary plane $S\lambda\rho = 1$. This number is equal to the order of the scalar binary equation in t, which is obtained by substituting in the equation of the plane the vector to a point on the curve expressed in terms of the parameter t. Arranged in powers of t, the result is

$$(S\lambda a_0 - a_0)t^n + n(S\lambda a_1 - a_1)t^{n-1} + \tfrac{1}{2}n(n-1)(S\lambda a_2 - a_2)t^{n-2} + \&c. = 0,$$

which gives n values of the parameter, or determines n points in the plane, where t^n is the highest power of t in the numerator or in the denominator of the given vector expression.

2. *Vector equation for a tangent line and osculating plane.*

It is sometimes convenient to suppose the numerator and the denominator of the vector expression to be rendered homogeneous in x and y, where $ty = x$. In this case

$$\rho = \frac{(a_0 a_1 \ldots a_n)(xy)^n}{(a_0 a_1 \ldots a_n)(xy)^n} = \frac{\phi(xy)}{f(xy)},$$

and here $\phi(xy)$ is a binary quantic with vector coefficients, and $f(xy)$ a binary quantic with scalar coefficients, and in general both quantics

are of the order n. The point on the curve determined by $x = x_1$ and $y = y_1$ may be called the point x_1y_1.

Vector expressions for the tangent line and the osculating plane at x_1y_1 may be readily assigned.

The equation of the tangent line is

$$\rho = \frac{\left(x\dfrac{d}{dx_1} + y\dfrac{d}{dy_1}\right)\phi(x_1y_1)}{\left(x\dfrac{d}{dx_1} + y\dfrac{d}{dy_1}\right)f(x_1y_1)},$$

where x_1y_1 are given, and xy variable. This is in fact the equation of a right line passing through x_1y_1, as appears on putting $x = x_1$ and $y = y_1$, and also passing through the consecutive points $x_1 + dx_1$ and $y_1 + dy_1$, as also appears on putting $x = x_1 + ndx_1$ and $y = y_1 + ndy_1$, and using Euler's theorem on homogeneous functions.

The vector expression for the osculating plane at the same point is, if u, v, and w are variable parameters (whose ratios only are essential),

$$\rho = \frac{\left(u\dfrac{d^2}{dx_1^2} + v\dfrac{d^2}{dx_1dy_1} + w\dfrac{d^2}{dy_1^2}\right)\phi(x_1y_1)}{\left(u\dfrac{d^2}{dx_1^2} + v\dfrac{d^2}{dx_1dy_1} + w\dfrac{d^2}{dy_1^2}\right)f(x_1y_1)}.$$

Retaining only terms of the second order, it is obviously possible to expand

$$\phi(x_1 + dx_1 + \tfrac{1}{2}d^2x_1,\ y_1 + dy_1 + \tfrac{1}{2}d^2y_1)$$

in the form

$$\left(u_1\frac{d^2}{dx_1^2} + v_1\frac{d^2}{dx_1dy_1} + w_1\frac{d^2}{dy_1^2}\right)\phi(x_1y_1),$$

in which u_1, v_1, and w_1 are independent of the coefficients of ϕ, and involve only x_1, y_1, their deriveds, and the number n which determines the order of the binary $\phi(xy)$. This being so, the vector expression lately written involving linearly two independent parameters (the ratios of u, v, and w), is seen to represent the osculating plane at x_1y_1, as in the neighbourhood of the point the deviation of the curve from the plane is a quantity of the third order.

3. *Example.—Poles of chords of a conic.*

I pass on now to consider the vector expressions for a conic, the the pole of a chord, and the centre of the curve.

By the first article, the general equation of a conic is

$$\rho = \frac{a_0 x^2 + 2a_1 xy + a_2 y^2}{a_0 x^2 + 2a_1 xy + a_2 y^2},$$

and, by the second article, the tangent at $x_1 y_1$ is

$$\rho = \frac{x(a_0 x_1 + a_1 y_1) + y(a_1 x_1 + a_2 y_1)}{x(a_0 x_1 + a_1 y_1) + y(a_1 x_1 + a_2 y_1)}$$

Given both $x_1 y_1$ and $x_2 y_2$, the point

$$\varpi = \frac{a_0 x_1 x_2 + a_1(x_1 y_2 + x_2 y_1) + a_2 y_1 y_2}{a_0 x_1 x_2 + a_1(x_1 y_2 + x_2 y_1) + a_2 y_1 y_2}$$

is situated on the tangent at $x_1 y_1$, and on that at $x_2 y_2$. This point is consequently the pole of the chord joining the two given points on the curve.

Two points on the curve may be considered as given by the quadratic equation

$$b_0 x^2 + 2b_1 xy + b_2 y^2 = 0,$$

the vectors to these points being determined by substituting the roots of this quadratic in the vector expression for the conic. The pole of the line joining these two points is

$$\varpi = \frac{a_0 b_2 - 2a_1 b_1 + a_2 b_0}{a_0 b_2 - 2a_1 b_1 + a_2 b_0};$$

since $\quad x_1 y_2 + x_2 y_1 = -2b_1, \quad$ and $\quad x_1 x_2 = b_2, \quad$ if $\quad y_1 y_2 = b_0$.

The points at infinity on the conic are determined by the quadratic

$$a_0 x^2 + 2a_1 xy + a_2 y^2 = 0,$$

since, when this vanishes, the vectors to the points determined are infinitely long. The pole of the chord joining these points, or the centre of the conic is

$$\rho_0 = \frac{a_0 a_2 - 2a_1 a_1 + a_2 a_0}{2(a_0 a_2 - a_1^2)}.$$

4. *Invariants of binary quantics with non-commutative coefficients.*

The following rule may consequently be stated:—In order to determine the pole ϖ of the chord joining the points determined by

$$b_0x^2 + 2b_1xy + b_2y^2 = 0,$$

form the $(12)^2$ invariant of this scalar quadratic, and of the vector quadratic

$$(a_0 - a_0\varpi)x^2 + 2(a_1 - a_1\varpi)xy + (a_2 - a_2\varpi)y^2,$$

and equate to zero the result.

This suggests consideration of invariants derived from binary functions of xy whose coefficients are not commutative. In other words, the investigation is suggested of those functions of the coefficients of the various powers of x and y in the expressions

$$(p_0p_1p_2 \ldots p_n)(xy)^n, \quad \text{and} \quad (q_0q_1 \ldots q_{n'})(xy)^{n'},$$

which remain unaltered when a linear scalar transformation is effected on x and y. As it is generally impossible to determine values of x and y which shall make these binary functions vanish, it is most convenient to treat these invariants by means of differential operators.

Suppose

$$x = lX + mY, \quad \text{and} \quad y = l'X + m'Y,$$

and suppose that when this scalar transformation is made,

$$(p_0p_1 \ldots p_n)(xy)^n = (P_0P_1 \ldots P_n)(XY)^n,$$

and

$$(q_0q_1 \ldots q_{n'})(xy)^{n'} = (Q_0Q_1 \ldots Q_{n'})(XY)^{n'};$$

or, in other words, suppose that the binaries on the left-hand side of these equations transform into the binaries on the right.

Now, for this linear transformation,

$$l\frac{d}{dY} - m\frac{d}{dX} = (lm' - l'm)\frac{d}{dy},$$

and

$$l'\frac{d}{dY} - m'\frac{d}{dX} = -(lm' - l'm)\frac{d}{dx};$$

and, consequently,

$$(lm' - l'm)^n(p_0p_1 \ldots p_n)\left(\frac{d}{dy}, -\frac{d}{dx}\right)^n = (P_0P_1 \ldots P_n)\left(\frac{d}{dY}, -\frac{d}{dX}\right)^n.$$

Hence

$$(lm' - l'm)^n . (p_0 p_1 \ldots p_n) \left(\frac{d}{dy}, -\frac{d}{dx}\right)^n . (q_0 q_1 \ldots q_{n'}) (xy)^{n'}$$

$$= (P_0 P_1 \ldots P_n) \left(\frac{d}{dY}, -\frac{d}{dX}\right)^n . (Q_0 Q_1 \ldots Q_{n'}) (XY)^{n'};$$

and this is a definite covariant quantic of the order $n' - n$ in x and y, provided the order of multiplication of the non-commutative coefficients p and q, and P and Q is preserved. In this case the operator is written to the left of the operand. The new covariant

$$(lm' - l'm)^n (q_0 q_1 \ldots q_{n'}) (xy)^{n'} . (p_0 p_1 \ldots p_n) \left(\frac{d}{dy}, -\frac{d}{dx}\right)^n$$

$$= (Q_0 Q_1 \ldots Q_{n'}) (XY)^{n'} (P_0 P_1 \ldots P_n) \left(\frac{d}{dY}, -\frac{d}{dX}\right)^n,$$

is found when the operator is written to the right of the operand. This covariant differs from the former only in the order of multiplication of the p and q, and of the P and Q. Here p is always to the right of q, and P to the right of Q; in the other case, p is always to the left of q, and P to the left of Q.

When $n = n'$, these are invariants for the linear transformation. It is easy to extend this theory to any number of binary quantics, but the order in multiplying the coefficients must be carefully attended to.

5. *The vanishing of a vector invariant with respect to the parameter determines the pole of a given chord of a conic.*

Forming the $(12)^2$ invariant of the vector quadratic (in which ϖ is an arbitrary, but given vector),

$$(a_0 - \alpha_0 \varpi) x^2 + 2 (a_1 - \alpha_1 \varpi) xy + (a_2 - \alpha_2 \varpi) y^2,$$

and of the scalar quadratic

$$b_0 x^2 + 2 b_1 xy + b_2 y^2,$$

the result is

$$(a_0 - \alpha_0 \varpi) b_2 - 2 (a_1 - \alpha_1 \varpi) b_1 + (a_2 - \alpha_2 \varpi) b_0.$$

The invariant vanishes if, as in the third article, ϖ is the vector to the pole of the chord joining the points determined by equating to zero the quadratic

$$b_0 x^2 + 2 b_1 xy + b_2 y^2.$$

6. ***For any unicursal curve the vanishing of a corresponding invariant determines a definite point, the "pole" of n given points.***[1]

Take the general twisted curve of the n^{th} degree, and suppose the vector to a point on it to be given by

$$\rho = \frac{\phi(x, y)}{f(x, y)} = \frac{(a_0 a_1 \ldots a_n)(xy)^n}{(a_0 a_1 \ldots a_n)(xy)^n}.$$

Take also a scalar binary of the n^{th} degree

$$F(xy) = (b_0 b_1 b_2 \ldots b_n)(xy)^n = 0,$$

whose vanishing determines n definite points on the curve, and consider the $(12)^n$ invariant formed between this and

$$\varpi f(xy) - \phi(xy).$$

It may be written in the form

$$\varpi (fF)_n - (\phi F)_n,$$

where $(fF)_n$ is the $(12)^n$ invariant formed between the scalar binaries $f(xy)$ and $F(xy)$, and $(\phi F)_n$, that formed between $\phi(xy)$ and $F(xy)$.

If this invariant vanishes, a definite point is determined by the vector

$$\varpi = \frac{(\phi F)_n}{(fF)_n};$$

and, for the sake of brevity, this point may be called the *pole* of the n points on the given curve determined by $F(xy) = 0$.

In particular, when these n points lie in a given plane $S\lambda\rho = 1$, the binary $F(xy) = 0$ is replaced by the binary

$$S\lambda\phi(xy) - f(xy) = 0.$$

In this case

$$(fF)_n = S\lambda(f\phi)_n - (ff)_n, \quad \text{and} \quad (\phi F)_n = (\phi S\lambda\phi)_n - (\phi f)_n,$$

where

$$(f\phi)_n = a_0 a_n - n a_1 a_{n-1} + \&c. + (-)^n a_n a_0 = (-)^n (\phi f)_n$$

and

$$(\phi S\lambda\phi)_n = a_0 S\lambda a_n - n a_1 S\lambda a_{n-1} + \&c. + (-)^n a_n S\lambda a_0,$$

and

$$(ff)_n = a_0 a_n - n a_1 a_{n-1} + \&c. + (-)^n a_n a_0 = (-)^n (ff)_n.$$

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[1] The use of the word "pole" in this extended sense is due to Professor W. K. Clifford, who has given the theorems of Arts. 7 and 8 for curves of the n^{th} degree in n-dimensional space. "Classification of Loci," collected works, p. 312.

Thus the pole of the n coplanar points is given by

$$\varpi = \frac{(\phi S\lambda\phi)_n - (\phi f)_n}{S\lambda(f\phi)_n - (ff)_n}.$$

In particular, as the points at infinity are determined by $f(xy) = 0$, the pole of the points at infinity is

$$\varpi_0 = \frac{(\phi f)_n}{(ff)_n}.$$

7. ***Distinction between curves of odd and even order. When n is odd, the pole of n coplanar points lies in their plane. The locus of poles of parallel planes is a right line parallel to a fixed direction.***

It is now convenient to consider separately curves of odd and curves of even order. Taking in the first place curves of odd order, $(ff)_n = 0$,

$$(\phi f)_n = a_0 a_n - a_n a_0 - n(a_1 a_{n-1} - a_{n-1} a_1) + \&c. = -(f\phi)_n,$$

and

$$\begin{aligned}(\phi S\lambda\phi)_n &= a_0 S\lambda a_n - a_n S\lambda a_0 - n(a_1 S\lambda a_{n-1} - a_{n-1} S\lambda a_1) + \&c.\\ &= V.V(a_0 a_n - n a_1 a_{n-1} + \tfrac{1}{2}n(n-1)a_2 a_{n-2} - \&c.)\lambda.\end{aligned}$$

Thus the pole of the points in the plane $S\lambda\rho = 1$ is given by the equation

$$\varpi = \frac{V\lambda\kappa + \iota}{S\lambda\iota},$$

in which

$$\iota = a_0 a_n - a_n a_0 - n(a_1 a_{n-1} - a_{n-1} a_1) + \&c.$$

and

$$\kappa = V(a_0 a_n - n a_1 a_{n-1} + \&c.).$$

In particular, the pole of the points at infinity is situated at the point at infinity on the line parallel to ι, since $(ff)_n = 0$.

Again, the pole of n coplanar points lies in their plane; for

$$S\lambda\varpi = S\lambda.\frac{(V\lambda\kappa + \iota)}{S\lambda\iota} = 1.$$

Further, the locus of the poles of a system of parallel planes $S\lambda\rho = t$, is found by replacing λ by $t^{-1}\lambda$, and is the right line

$$\rho = \frac{V\lambda\kappa + t\iota}{S\lambda\iota}.$$

These locus lines are all parallel to the vector ι; that is, they all pass

through the pole of the points at infinity. Again, the locus of poles for the system of planes

$$S\rho(t\lambda + s\mu) = t + s,$$

which pass through a fixed line, is the line

$$\rho = \frac{V(t\lambda + s\mu)\kappa + (t+s)\iota}{S(t\lambda + s\mu)\iota}.$$

8. ***When n is even, the pole of the points in a plane is the same as the pole of the plane with respect to a fixed quadric.***

In the second place, for curves of even order,

$$(ff)_n = 2(a_0a_n - na_1a_{n-1} + \&c.) = 2I, \text{ suppose};$$

$$(\phi f)_n = (f\phi)_n = a_0\alpha_n + a_n\alpha_0 - n(a_1\alpha_{n-1} + a_{n-1}\alpha_1) + \&c. = 2\iota;$$

and

$$(\phi S\lambda\phi)_n = \alpha_0 S\lambda\alpha_n + \alpha_n S\lambda\alpha_0 - n(\alpha_1 S\lambda\alpha_{n-1} + \alpha_{n-1}S\lambda\alpha_1) + \&c = 2\theta\lambda,$$

where θ is a self-conjugate linear vector function defined by the equation just given. And now the pole of the points in $S\lambda\rho = 1$ is, by Art. 6,

$$\varpi = \frac{\theta\lambda - \iota}{S\lambda\iota - I},$$

and the pole of the points at infinity is

$$\varpi_0 = \frac{\iota}{I}.$$

Just as in the last article, the locus of poles of the system of parallel planes $S\lambda\rho = t$ is

$$\rho = \frac{\theta\lambda - t\iota}{S\lambda\iota - tI};$$

and, as λ varies, all these locus lines pass through the point ϖ_0, the pole of the points at infinity.

For curves of even order, it is possible, by taking the origin at the point ϖ_0 to render the vector ι zero—at least, when I is not zero. This may be verified directly by changing the origin, and then forming the invariant ι; but it is otherwise obvious that this is the case, since $f(xy)$ is unaltered by a change of origin, and therefore I remains

unchanged. Or directly, changing the origin, the expression for the curve of order n (odd or even) becomes, when the origin is at ρ_0,

$$\rho = \frac{(a_0 - a_0\rho_0,\ a_1 - a_1\rho_0,\ \ldots\ a_n - a_n\rho_0)(xy)^n}{(a_0 a_1 \ldots a_n)(xy)^n}.$$

The invariant

$$(a_0 - a_0\rho_0)a_n - n(a_1 - a_1\rho_0)a_2 + \ldots + (-)^n(a_n - a_n\rho_0)a_0$$

may, when n is even, by choice of ρ_0 be made to vanish; but when n is odd, it is independent of ρ_0, and cannot be made to vanish by changing the origin.

Thus, for curves of even order, the pole of the points in $S\lambda\rho = 1$ is, if the origin is taken at the pole of the points at infinity,

$$\varpi = -I^{-1}\theta(\lambda),$$

and the locus of the poles of the system of parallel planes $S\lambda\rho = t$ is the line

$$\rho = -t^{-1}I^{-1}\theta(\lambda).$$

Let the quadric $S\rho\theta\rho = \text{const.}$ be constructed, then the locus of the poles of points in a system of planes at right angles to a given radius vector to the quadric is the central perpendicular to the corresponding tangent plane.

In this case, also, the locus of poles of the system of planes

$$S(t\lambda + s\mu)\rho = t + s,$$

which pass through a given line, is the line

$$\rho = -\frac{\theta(t\lambda + s\mu)}{I(t + s)}.$$

The pole of the plane $S\lambda\rho = 1$ being given by $\varpi = -I^{-1}\theta\lambda$, will not lie in the plane (as in the case of curves of odd order) unless

$$S\lambda\varpi = -I^{-1}S\lambda\theta\lambda = -IS\varpi\theta^{-1}\varpi = 1.$$

Thus the locus of poles which lie in the corresponding planes is the quadric surface $IS\rho\theta^{-1}\rho = -1$. The tangent plane at ϖ to this surface is

$$IS\rho\theta^{-1}\varpi = -1 \quad \text{or} \quad S\rho\lambda = 1,$$

and the quadric is also the envelope of the planes which contain their

poles. More generally, the pole of the plane $S\lambda\rho = t$ with respect to this quadric is the point

$$\varpi = -t^{-1}I^{-1}\theta\lambda,$$

and this is precisely the point which is the pole of the points in which the twisted curve meets the plane with respect to that twisted curve of even order.

9. *Standard vector expression for curves of even order.*

Remembering the definition of $(\phi S\lambda\phi)_n = 2\theta(\lambda)$ in Art. 6, it follows that, if λ and μ satisfy the relation $S\lambda\theta\mu = 0$, the $(12)^n$ invariants derived from the two scalar quantics $S\lambda\phi(xy)$ and $S\mu\phi(xy)$ vanishes. Hence, if λ, μ, and ν satisfy

$$S\mu\theta\nu = S\nu\theta\lambda = S\lambda\theta\mu,$$

and if

$$\phi(xy)\, S\lambda\mu\nu = V\mu\nu\, A(x, y) + V\nu\lambda\, B(x, y) + V\lambda\mu\, C(x, y),$$

where

$$A(x, y) = S\lambda\phi(x, y), \text{ \&c.},$$

the $(12)^n$ invariants $(BC)_n$, $(CA)_n$, and $(AB)_n$ of the scalar binaries all vanish. If, further, $S\lambda\theta\lambda = -I$, the $(12)^n$ invariants

$$(AA)_n = (BB)_n = (CC)_n = -2I.$$

If, again,

$$I\alpha = -\theta\lambda, \quad I\beta = -\theta\mu, \quad \text{and} \quad I\gamma = -\theta\nu,$$

it follows at once, since

$$S\lambda\alpha = 1, \quad \text{and} \quad S\mu\alpha = S\nu\alpha = 0, \quad \text{that} \quad \alpha S\lambda\mu\nu = V\mu\nu, \text{ \&c.},$$

and that α, β, and γ are conjugate radii of the quadric surface

$$IS\rho\theta^{-1}\rho = -1.$$

Hence the vector equation of the curve of even order may be written in the form

$$\rho = \frac{\alpha A(xy) + \beta B(xy) + \gamma C(xy)}{f(xy)},$$

where

$$(AA)_n = (BB)_n = (CC)_n = -(ff)_n = -2I.$$

and

$$(BC)_n = (CA)_n = (AB)_n = 0;$$

and, because

$$\iota = 0, \quad \text{or} \quad \alpha (Af)_n + \beta (Bf)_n + \gamma (Cf)_n = 0,$$

$$(Af)_n = (Bf)_n = (Cf)_n = 0.$$

If α, β, and γ are taken to be the principal axes of the quadric

$$IS\rho\theta^{-1}\rho = -1,$$

the additional simplicity of the mutual rectangularity of the coordinating vectors is obtained.

10. *Introduction of a second invariant, which cannot generally be made to vanish when n is odd, and is then a vector.*

Again, consider the invariant $(12)^n$, obtained by operating with the operator derived from the quantic

$$(\beta_0\beta_1\beta_2 \ldots \beta_n)(xy)^n$$

on the quantic itself. This is, by the principles of Art. 4,

$$\beta_0\beta_n - n\beta_1\beta_{n-1} + \ldots + (-)^n\beta_n\beta_0.$$

First, taking the case in which n is odd, the invariant is a vector, and its half is

$$V(\beta_0\beta_n - n\beta_1\beta_{n-1} + \&c.),$$

For example, if the binary quantic is

$$\rho (a_0a_1 \ldots a_n)(xy)^n - (\alpha_0\alpha_1 \ldots \alpha_n)(xy)^n,$$

the invariant is

$$V[(\rho a_0 - \alpha_0)(\rho a_n - \alpha_n) - n (\rho a_1 - \alpha_1)(\rho a_{n-1} - \alpha_{n-1}) + \&c.]$$

$$= V\rho [a_0\alpha_n - a_n\alpha_0 - n (a_1\alpha_{n-1} - a_{n-1}\alpha_1) + \ldots] + V(\alpha_0\alpha_n - n\alpha_1\alpha_{n-1} + \&c.)$$

$$= V\rho\iota + \kappa$$

in the notation of Art. 7. This invariant cannot in general be made to vanish by change of origin of vectors; if it vanishes, $S\iota\kappa = 0$, and this is not generally true. In fact, it is easy to see that, on change of origin, the invariant κ becomes $\kappa + V\rho_0\iota$, where ρ_0 is the vector to the new origin, and thus the scalar $S\kappa\iota$ is quite independent of the position of the origin, as it has been shown already that ι does not change with change of origin.

As an example, take the case of the general twisted cubic

$$\rho = \frac{a_0x^3 + 3a_1x^2y + 3a_2xy^2 + a_3y^3}{a_0x^3 + 3a_1x^2y + 3a_2xy^2 + a_3y^3}.$$

Here

$$\iota = a_0a_3 - a_3a_0 - 3(a_1a_2 - a_2a_1),$$

and

$$\kappa = Va_0a_3 - 3Va_1a_2.$$

The origin may be supposed to be taken on the curve, so that $a_3 = 0$. Then if $\iota = 0$, a_0, a_1, and a_2 are coplanar, and the curve must be plane; if $S\iota\kappa = 0$, $Sa_0a_1a_2 = 0$, and again the curve is plane; if $\kappa = 0$, a_1 is parallel to a_2, and here again the curve is plane.

11. *But when n is even, it is scalar, and its vanishing determines the director sphere of the quadric of Art.* 8.

When n is even, this invariant is a scalar, and its half is

$$S\beta_0\beta_n - nS\beta_1\beta_{n-1} + \&c.,$$

in which the last coefficient must be halved.

The binary quantic

$$\rho(a_0a_1 \ldots a_n)(xy)^n - (a_0a_1 \ldots a_n)(xy)^n$$

affords the invariant

$$S(a_0\rho - a_0)(a_n\rho - a_n) - nS(a_1\rho - a_1)(a_{n-1}\rho - a_{n-1}) + \&c.$$
$$= \rho^2I - 2S\rho\iota + (Sa_0a_n - nSa_1a_{n-1} + \&c.),$$

using the notation of the 8th Article.

If this invariant vanishes, the vector ρ must terminate on a sphere whose centre is the point $I^{-1}\iota$ – the pole of the points at infinity. For this point as origin, the equation of the sphere is

$$\rho^2I + Sa_0a_n - nSa_1a_{n-1} + \&c. = 0.$$

Consider an ellipse referred to its centre as origin with α and β for its axes major and minor; the equation of the ellipse is

$$\rho = \alpha\cos u + \beta\sin u = \frac{\alpha(1-t^2) + 2\beta t}{1+t^2}, \quad \text{if} \quad t = \tan\tfrac{1}{2}u.$$

For this curve, $I = 1$, and the equation of the sphere is

$$\rho^2 = \alpha^2 + \beta^2;$$

that is, the sphere contains the director circle of the conic as a great circle. A similar result holds for the hyperbola

$$\rho = a \cosh u + \beta \sinh u = \frac{a(1+t^2) + 2\beta t}{1-t^2}, \quad \text{if} \quad t = \tanh \tfrac{1}{2}u.$$

Taking the equation of the general unicursal curve of even order in the standard form given in Art. 9, the invariant of the present article, being the $(12)^n$ invariant of the quantic

$$\rho f(xy) - aA(xy) - \beta B(xy) - \gamma C(xy),$$

reduces at once to

$$\rho^2 - a^2 - \beta^2 - \gamma^2 = 0,$$

and the sphere is the director sphere of the quadric

$$IS\rho\theta^{-1}\rho = -1.$$

Referring to the list of vanishing invariants which is given at the close of the aiticle cited, there is no difficulty in proving this.

12. *Formation of a system of curves called "Emanants," projective with the original curve.*

From any binary quantic a system of emanants may be derived by the aid of operators of the type

$$x_1 \frac{d}{dx} + y_1 \frac{d}{dy}.$$

In connexion with a curve

$$\rho = \frac{\phi(xy)}{f(xy)}$$

of order n, may be considered the emanant curve

$$\rho = \frac{\left(x \dfrac{d}{dx_1} + y \dfrac{d}{dy_1}\right)^p \phi(x_1 y_1)}{\left(x \dfrac{d}{dx_1} + y \dfrac{d}{dy_1}\right)^p f(x_1 y_1)}$$

of order p, if x, y are regarded as variable, and x_1, y_1 as given. Now, if ψ is any linear vector function, the original curve is projected by operating by ψ, and replacing $\psi\rho$ by ρ. Thus

$$\rho = \psi \cdot \frac{\phi(xy)}{f(xy)}$$

is the equation of the projected curve, and as the constant function ψ and the operator

$$x\frac{d}{dx_1}+y\frac{d}{dy_1}$$

are commutative in order of operation, the emanant curves project into emanants of the projected curve.

The emanants of any order p defined by x_1y_1, have the same tangent line and osculating plane at the point

$$\rho=\frac{\phi(x_1y_1)}{f(x_1y_1)},$$

at which they meet the original curve. For, at any point $x=x_2$, $y=y_2$ on the emanant, the tangent line is

$$\rho=\frac{\left(x\frac{d}{dx_1}+y\frac{d}{dy_1}\right)\left(x_2\frac{d}{dx_1}+y_2\frac{d}{dy_1}\right)^{p-1}\phi(x_1y_1)}{\left(x\frac{d}{dx_1}+y\frac{d}{dy_1}\right)\left(x_2\frac{d}{dx_1}+y_2\frac{d}{dy_1}\right)^{p-1}f(x_1y_1)},$$

and this becomes identical with the tangent line at x_1y_1 to the original curve when $x_2=x_1$ and $y_2=y_1$.

In like manner, the osculating plane at x_2y_2 on the emanant is

$$\rho=\frac{\left(u\frac{d^2}{dx_1^2}+v\frac{d^2}{dx_1dy_1}+w\frac{d^2}{dy_1^2}\right)\left(x_2\frac{d}{dx_1}+y_2\frac{d}{dy_1}\right)^{p-2}\phi(x_1y_1)}{\left(u\frac{d^2}{dx_1^2}+v\frac{d^2}{dx_1dy_1}+w\frac{d^2}{dy_1^2}\right)\left(x_2\frac{d}{dx_1}+y_2\frac{d}{dy_1}\right)^{p-2}f(x_1y_1)},$$

and this is, when $x_1=x_2$, and $y_1=y_2$, the same as the osculating plane at x_1y_1 to the original curve.

13. *General properties of the emanant curves.*

The emanant at x_1y_1 of order p intersects the emanant at x_2y_2 of order $n-p$. In fact,

$$\rho=\frac{\left(x_2\frac{d}{dx_1}+y_2\frac{d}{dy_1}\right)^{p}\phi(x_1y_1)}{\left(x_2\frac{d}{dx_1}+y_2\frac{d}{dy_1}\right)^{p}f(x_1y_1)}=\frac{\left(x_1\frac{d}{dx_2}+y_1\frac{d}{dy_2}\right)^{n-p}\phi(x_2y_2)}{\left(x_1\frac{d}{dx_2}+y_1\frac{d}{dy_2}\right)^{n-p}f(x_2y_2)},$$

is a point common to the two curves. Again, as the equation of the

tangent line at the point whose parameter is $x_2 : y_2$ on the emanant at x_1y_1 of order p may be written in either of the forms

$$\rho = \frac{\left(x\frac{d}{dx_1} + y\frac{d}{dy_1}\right)\left(x_2\frac{d}{dx_1} + y_2\frac{d}{dy_1}\right)^{p-1}\phi(x_1y_1)}{\left(x\frac{d}{dx_1} + y\frac{d}{dy_1}\right)\left(x_2\frac{d}{dx_1} + y_2\frac{d}{dy_1}\right)^{p-1}f(x_1y_1)},$$

or

$$\rho = \frac{\left(x\frac{d}{dx_2} + y\frac{d}{dy_2}\right)\left(x_1\frac{d}{dx_2} + y_1\frac{d}{dy_2}\right)^{n-p}\phi(x_2y_2)}{\left(x\frac{d}{dx_2} + y\frac{d}{dy_2}\right)\left(x_1\frac{d}{dx_2} + y_1\frac{d}{dy_2}\right)^{n-p}f(x_2y_2)};$$

the emanant at x_1y_1 of order p has a common tangent line with the emanant at x_2y_2 of order $n - p + 1$.

And, similarly, as the osculating plane at the point x_2y_2 on the emanant of order p at x_1y_1 is

$$\rho = \frac{\left(u\frac{d^2}{dx_1^2} + v\frac{d^2}{dx_1dy_1} + w\frac{d^2}{dy_1^2}\right)\left(x_2\frac{d}{dx_1} + y_2\frac{d}{dy_1}\right)^{p-2}\phi(x_1y_1)}{\left(u\frac{d^2}{dx_1^2} + v\frac{d^2}{dx_1dy_1} + w\frac{d^2}{dy_1^2}\right)\left(x_2\frac{d}{dx_1} + y_2\frac{d}{dy_1}\right)^{p-2}f(x_1y_1)},$$

or

$$\rho = \frac{\left(u\frac{d^2}{dx_2^2} + v\frac{d^2}{dx_2dy_2} + w\frac{d^2}{dy_2^2}\right)\left(x_1\frac{d}{dx_2} + y_1\frac{d}{dy_2}\right)^{n-p}\phi(x_2y_2)}{\left(u\frac{d^2}{dx_2^2} + v\frac{d^2}{dx_2dy_2} + w\frac{d^2}{dy_2^2}\right)\left(x_1\frac{d}{dx_2} + y_1\frac{d}{dy_2}\right)^{n-p}f(x_2y_2)};$$

this plane osculates likewise the emanant at x_2y_2 of order $n - p + 2$.

Again, if both x_1y_1 and x_2y_2 vary together,

$$\rho = \frac{\left(x_2\frac{d}{dx_1} + y_2\frac{d}{dy_1}\right)^{p}\phi(x_1y_1)}{\left(x_2\frac{d}{dx_1} + y_2\frac{d}{dy_1}\right)^{p}f(x_1y_1)},$$

is the equation of a surface which is the locus of emanants of order p, or of order $n - p$. In particular, the first emanants and the tangent lines are curves on the developable whose cuspidal edge is the given curve.

Mixed emanants may also be considered; but it seems to be desirable to explain, in the first instance, a notation which may be conveniently used in discussing their properties.

14. *Syzygy of points, curves, and planes.*

Take for example a conic. Let the point x_1y_1 on it be denoted by the symbol (11), and the tangent line thereat by the symbol (1). A point on this tangent line may be denoted by the symbol (12) or (21), and the second tangent through this point may be denoted by (2), and its point of contact by (22).

Again, for a cubic, the first or conic emanant at x_1y_1 may be symbolized by (1), the tangent line at the point by (11), the osculating plane by [1], and the point itself by (111). The point whose parameter is $x_2 : y_2$ on the conic (1) may be called (122), and the tangent line thereat (12) or (21). In general, the order in which the figures occur within the brackets is arbitrary.

Two figures complete a syzygy for a conic, consisting of two points (11) and (22) on the conic, their pole (12), and the tangents (1) and (2).

15. *Description of a syzygy for the twisted cubic.*

For a cubic a complete syzygy of points, curves, and planes may be derived from three figures. In the osculating plane [1] lie the points, lines, and the conic involving the figure 1 in their symbol. The planes [1] and [2] intersect in the line (12). The lines of intersection of the three osculating planes [1], [2], and [3] are (23), (31), and (12), and they intersect in the point (123). This point has been called in Art. 6 the pole of the three points (111), (222), and (333).

In the plane [1] are the lines (11), (12), and (13), and these are tangents at the points (111), (122), and (133) to the conic (1). The points (122) and (133) are the points in which the tangents (22) and (33) to the cubic meet the plane [1]. But since the lines joining the points of contact of a conic inscribed in a triangle to the opposite vertices concur, the lines joining (111) to (123), (122) to (113), and (133) to (112) concur in some point P_1. If P_2 and P_3 are points similarly formed in the planes [2] and [3], the following groups of collineations may be written down:—

$$(111), (123), P_1;\ (122), (113), P_1;\ (133), (112), P_1;$$

$$(222), (123), P_2;\ (233), (221), P_2;\ (211), (223), P_2;$$

$$(333), (123), P_3;\ (311), (332), P_3;\ (322), (331), P_3.$$

Again, taking a plane through the points (113), (221), and (332); in virtue of the collineations it passes through P_1, P_2, and P_3. In like

manner, a plane through (112), (223), and (331) passes through P_1, P_2, and P_3; and since these planes do not in general coincide, P_1, P_2, and P_3 must lie on a line. Hence it follows that (111), (222), (333), and (123) lie in a plane, as has been more generally proved for curves of odd order in the 7th article.[1]

16. *Linear construction for this syzygy.*

The properties proved in the last article give a means of constructing, not only the conics, but the three points of osculation, when the osculating planes and the tangents are given.

The intersections of the planes determine the lines (23), (31), and (12). In the plane [1], the five points (112), (113), (122), (123), and (133) are given, since they are points of intersection of the given and constructed lines. The point P_1 is constructed by joining (122) to (113), and (133) to (112); and the point (111) lies on the line joining P_1 to (123). The conic (1) in this plane is uniquely determined, as it has to touch the three lines (11), (12), and (13) at the constructed points (111), (112), and (113).

It should be remembered that it has been proved, in Art. 13, that these conics lie on the tangent-line developable of the cubic. The theorem respecting the locus of their centres, given in Salmon's "Three Dimensions," will be generalized in a future article of the present Paper.[2]

17. *Syzygy for the twisted quartic.*

The syzygy for the twisted quartic

$$\rho = \frac{(a_0a_1a_2a_3a_4)(xy)^4}{(\overline{a_0a_1a_2a_3a_4})(\overline{xy})^4},$$

consists of the following system:—Denoting a point on the curve by (1111), the first emanant (a twisted cubic) at this point by (1), the second emanant (a conic) by (11), the tangent line by (111), and the osculating plane by [11]; there are four sets of points, cubics, conics, lines, and planes, whose symbols involve only one of the four figures 1, 2, 3, and 4. In addition, there are the mixed emanant conics (12), and their planes [12]. The conic (12) may be described either as the

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[1] See Art. 337 of Dr. Salmon's "Three Dimensions."

[2] See "Three Dimensions," Art. 340; and Art. 21 of this Paper.

conic emanant at the point (1222) on the cubic (1), or as that at (2111) on the cubic (2). This conic (12) is related to the conics (11) and (22) as follows. The planes [11] and [12] intersect in the line (112) which touches the conic (11) at (1122), and also the conic (12) at (1112). Similarly, the line (122) lies in the planes [22] and [12], and this line touches (22) at (1122), and (12) at (1222). The line of intersection of [11] and [22] cannot be expressed by a symbol of the kind here used, but (1122) is a point on it. The point (1122) lies on each of the conics (11) and (22), and the plane [12] touches both the conics at this point, as it contains the tangent to each. Again, this point (1122) is the pole of the chord joining (1112) and (2212), two points on the conic (12). These points lie on tangents to the quartic, and generally (12) meets the tangents (111) and (222), tangents to the quartic, and to the conics (11) and (22) respectively.

Again, for three figures, there is the line (123), through which the planes [23], [31], and [12] pass, and which is a tangent to the three conics (23), (31), and (12) at (1123), (2231), and (3312), respectively. Similarly, introducing a fourth figure, three new lines (234), (314), and (124) are found, and these lines intersect with (123) in the point (1234), which is the pole of the four assumed points. Through this pole pass the six planes of the type [12], which intersect by threes in the lines of the type (123).

18. *Remarks on the general syzygy.*

In general, for a curve of the n^{th} degree, the pole of n points x_1y_1; x_2y_2; . . . x_ny_n may be denoted by the symbol (1, 2, . . . n). Through this point pass $\frac{1}{2}n(n-1)$ planes of the type [1, 2, . . . $(n-2)$], whose symbols involve only $(n-2)$ of the n figures. These planes intersect in n lines (1, 2, . . . $(n-1)$), through each of which $n-1$ planes pass. Given $n-1$ points, and combining them with an arbitrary n^{th} point on the curve, the locus of the poles is the line (1, 2, . . . $(n-1)$). Given only $(n-2)$ points, and combining them with two arbitrary points, the locus of the poles is the plane [1, 2, . . . $(n-2)$]; but if the same arbitrary point is taken twice over, the locus is the conic (1, 2, . . . $(n-2)$). In general, the ema nant curves may be considered as loci of poles. Thus the first emanant (1) is the locus of the poles of the system consisting of a given point x_1y_1, and an arbitrary point xy taken $n-1$ times.

19. *The osculating planes of the quartic envelop the quadric of Art.* 8.

More especially for the quartic curve, it is easy to show that its osculating planes envelop the quadric $IS\rho\theta^{-1}\rho = -1$ of Art. 8. Taking the point x_1y_1 three times over, and an arbitrary point x_2y_2 once, the pole is (1112), and it lies on the tangent (111) to the quartic. Now, in the osculating plane [11] the points are x_1y_1 taken three times over, and the fourth point $x'_1y'_1$, in which the plane meets the curve. The pole (111$1'$) of these four coplanar points lies in their plane, and consequently lies on the quadric $IS\rho\theta^{-1}\rho = -1$, and the osculating plane is the tangent plane thereat. It should be noticed also that, taking the point (1111) twice, and two other points x_3y_3 and x_4y_4, which lie in a plane with (1111) taken twice, that is to say, the points which lie in a plane through the tangent line (111), the locus of their poles (1134) is a right line in the osculating plane. For, the points being coplanar, the theorem of Art. 8 holds good, and the locus of poles of a system of planes through a line with respect to a quadric surface is a right line. This line meets the conic (11) in two points. Corresponding to these poles, the variable plane touches the quartic in a second point, or it contains two tangent lines, or every tangent to the quartic meets two others, or the rank of the developable formed by these tangent lines is 6,[1] as will be otherwise proved later on.

It will also be shown that there are four planes which pass through four consecutive points on the curve. The theorem of Art. 8 holds with respect to one of these points taken four times. These four points consequently lie on the quadric $IS\rho\theta^{-1}\rho = -1$, and as the osculating planes touch the quadric, the quartic touches it likewise at each of the four points.

20. *Characteristics and reciprocal of unicursal curves.*

There is no difficulty in determining the characteristics of these unicursal curves, using the principles laid down in Arts. 326 and 327 of Salmon's "Three Dimensions." In accordance with Dr. Salmon's

[1] See "Three Dimensions," Art. 330. The number of tangents which meet a given tangent is $r - 4$, where r is the rank.

notation, suppose the degree of the curve to be m. The scalar equation of the osculating plane is

$$S\rho\,.\left(\frac{d^2f}{dx^2}\cdot\frac{d^2\phi}{dxdy}\;\frac{d^2\phi}{dy^2}+\frac{d^2f}{dxdy}\cdot\frac{d^2\phi}{dy^2}\;\frac{d^2\phi}{dx^2}+\frac{d^2f}{dy^2}\cdot\frac{d^2\phi}{dx^2}\;\frac{d^2\phi}{dxdy}\right)$$
$$= S\,.\frac{d^2\phi}{dx^2}\;\frac{d^2\phi}{dxdy}\;\frac{d^2\phi}{dy^2};$$

and as this involves $x : y$ in the degree $3(m-2)$, the number of osculating planes through an arbitrary point is $n = 3(m-2)$.

In like manner, if the tangent (in which x' and y' are variable)

$$\rho = \frac{x'\dfrac{d\phi}{dx}+y'\dfrac{d\phi}{dy}}{x'\dfrac{df}{dx}+y'\dfrac{df}{dy}}$$

meets an arbitrary line $\qquad \rho = \alpha + t\beta,$

$$S\alpha\beta\left(\frac{d\phi}{dx}\cdot\frac{df}{dy}-\frac{d\phi}{dy}\cdot\frac{df}{dx}\right)=S\frac{d\phi}{dx}\;\frac{d\phi}{dy}\,\beta;$$

and as this involves $x : y$ in the degree $2(m-1)$, the rank of the curve is $r = 2(m-1)$. From these three all the characteristics may be deduced.

It is simpler, perhaps, to notice that the curve is the reciprocal with respect to the sphere $\rho^2 + 1 = 0$ of the plane

$$S\rho\phi(xy) + f(xy) = 0,$$

which involves the parameter $x : y$ in the degree m. The characteristics of the curve are thus the reciprocals of those given in Art. 329 of the "Three Dimensions." They are, in Dr. Salmon's notation,

$$a = 4(m-3);\quad x = 2(m-1)(m-3);\quad h = \tfrac{1}{2}(m-1)(m-2);$$
$$\beta = 0;\qquad y = 2(m-2)(m-3);\quad g = \tfrac{1}{2}(9m^2 - 53m + 80).$$

In Art. 349 it is shown that the quartic considered in Art. 17 of the present Paper is the excubo-quartic through which only one quadric surface can be drawn.

21. *Extension of a theorem of Cremona's.*

The extension of Cremona's theorem, referred to in the note to Art. 16, is as follows: the locus of the pole of the points in which a variable first emanant meets a fixed plane, is a conic section. Or still more generally, let the first emanant be

$$\rho = \frac{\left(x_1 \frac{d}{dx} + y_1 \frac{d}{dy}\right)\phi}{\left(x_1 \frac{d}{dx} + y_1 \frac{d}{dy}\right)f},$$

and consider the locus of the pole of the points determined by the first emanant

$$x_1 \frac{dF}{dx} + y_1 \frac{dF}{dy} = 0,$$

where $F(xy) = 0$ is a scalar binary of the n^{th} degree. In the notation of Art. 6, the pole is

$$\varpi = \frac{\left\{\left(x_1 \frac{d}{dx} + y_1 \frac{d}{dy}\right)\phi \, . \left(x_1 \frac{d}{dx} + y_1 \frac{d}{dy}\right)F\right\}_{n-1}}{\left\{\left(x_1 \frac{d}{dx} + y_1 \frac{d}{dy}\right)f \, . \left(x_1 \frac{d}{dx} + y_1 \frac{d}{dy}\right)F\right\}_{n-1}}$$

$$= \frac{x_1^2\left(\frac{d\phi}{dx}\cdot\frac{dF}{dx}\right)_{n-1} + x_1y_1\left[\left(\frac{d\phi}{dx}\cdot\frac{dF}{dy}\right)_{n-1} + \left(\frac{d\phi}{dy}\cdot\frac{dF}{dx}\right)_{n-1}\right] + y_1^2\left(\frac{d\phi}{dy}\cdot\frac{dF}{dy}\right)_{n-1}}{x_1^2\left(\frac{df}{dx}\cdot\frac{dF}{dx}\right)_{n-1} + x_1y_1\left[\left(\frac{df}{dx}\cdot\frac{dF}{dy}\right)_{n-1} + \left(\frac{df}{dy}\cdot\frac{dF}{dx}\right)_{n-1}\right] + y_1^2\left(\frac{df}{dy}\cdot\frac{dF}{dx}\right)_{n-1}}.$$

Here, as in the article cited, $\left(\frac{d\phi}{dx}\cdot\frac{dF}{dx}\right)_{n-1}$ is the $(12)^{n-1}$ invariant of the binaries of the order $n-1$, and it is evident, that if $x_1 : y_1$ varies, the locus of the poles is a conic section.

22. *Unicursal curve regarded as the locus of the mean centre of corresponding points on any number of homographically divided lines.*

The general unicursal curve admits of a simple geometrical construction. Let $e_1e_2 \ldots e_n$ be the roots of $f(t, 1) = 0$, and let the curve be

$$\rho = \frac{\phi(t, 1)}{f(t, 1)} = \frac{(\alpha_0\alpha_1 \ldots \alpha_n)(t, 1)^n}{(a_0a_1 \ldots a_n)(t, 1)^n}.$$

Now

$$\rho = \frac{\alpha_0}{a_0} + \frac{a_0\phi(t) - \alpha_0 f(t)}{f(t)}$$

$$= \frac{\alpha_0}{a_0} + \Sigma \frac{a_0\phi(e_1) - \alpha_0 f(e_1)}{(t - e_1) f'(e_1)},$$

by the method of partial fractions; or, if

$$\epsilon_1 = -\frac{a_0\phi(e_1)}{f'(e_1)}, \quad \rho = \frac{\alpha_0}{a_0} + \Sigma \frac{\epsilon_1}{e_1 - t}$$

is the equation of the curve. Here $\epsilon_1, \epsilon_2 \ldots \epsilon_n$ are the vectors parallel to the asymptotes, and the construction is:—Take a system of n lines through a point, and divide them homographically; the locus of the mean centre of corresponding points on the homographically divided lines is a unicursal curve of the most general kind. If the lines are real, and the homographic divisions also real, the curve has n real asymptotes to which these lines are parallel.

The line $\rho = \dfrac{n\epsilon_1}{e_1 - t}$ is homographically divided when e_1 is given and t variable. The corresponding point on the line parallel to ϵ_2 is $\dfrac{n\epsilon_2}{e_2 - t}$, and adding all these and dividing by n, the validity of the construction is evident.

Suppose, however, that $f(t, 1) = 0$ has a pair of conjugate roots, $e_1 \pm \sqrt{-1}\, e_1'$. The terms arising from these are:

$$\frac{a_0\phi(e_1 + \sqrt{-1}\, e_1')}{(t - e_1 - \sqrt{-1}\, e_1') f'(e_1 + \sqrt{-1}\, e_1')} + \frac{a_0\phi(e_1 - \sqrt{-1}\, e_1')}{(t - e_1 + \sqrt{-1}\, e_1') f'(e_1 - \sqrt{-1}\, e_1')}$$

$$= \frac{\epsilon_1 + \sqrt{-1}\, \epsilon_1'}{e_1 + \sqrt{-1}\, e_1' - t} + \frac{\epsilon_1 - \sqrt{-1}\, \epsilon_1'}{e_1 - \sqrt{-1}\, e_1' - t} = 2\frac{(e_1 - t)\,\epsilon_1 + e_1'\epsilon_1'}{(e_1 - t)^2 + e_1'^2}.$$

Thus, when two of the roots of $f(t, 1) = 0$ are imaginary, the corresponding homographically divided lines are imaginary also; but they combine into a real ellipse. In a similar manner, if two roots are equal, a parabola replaces two of the lines.

The quartic having four real asymptotes may be described as the locus of the mean point of a tetrahedron whose vertices determine homographic divisions on four given lines. If only two asymptotes are real, the locus is the mean point of a triangle, two of whose vertices determine homographic divisions on two lines parallel to the asymptotes, while the third vertex determines homographic divisions on a conic. Finally, if the curve has no real asymptote, it is the locus of the middle point of a line joining homographic points on two given conics; or, more generally, it is the locus of a point dividing in a given ratio the line joining corresponding points on a pair of conics homographically divided.[1]

To form the equation of an asymptote of $\rho = \Sigma \dfrac{\epsilon_1}{e_1 - t}$, notice that the equation of a tangent is

$$\rho = \Sigma \frac{\epsilon_1 (e_1 - t)}{(e_1 - t_0)^2}; \text{ or, writing } x = \frac{e_1 - t}{(e_1 - t_0)^2},$$

$$\rho = x\epsilon_1 + \Sigma \frac{\epsilon_2 \left[e_2 - e_1 - x(e_1 - t_0)^2\right]}{(e_2 - t_0)^2}.$$

When $t_0 = e_1$,

$$\rho = x\epsilon_1 + \Sigma \frac{\epsilon_2}{e_2 - e_1}$$

is the equation of the asymptote parallel to ϵ_1, the sign Σ including $(n - 1)$ terms.

Thus, for a conic, the centre is $\dfrac{\epsilon_1 - \epsilon_2}{e_1 - e_2}$, as the vector to this point is on both asymptotes. The equation of the conic referred to its centre is easily seen to be

$$\rho = \frac{\epsilon_1}{e_2 - e_1} \cdot \frac{e_2 - t}{e_1 - t} + \frac{\epsilon_2}{e_1 - e_2} \cdot \frac{e_1 - t}{e_2 - t},$$

or

$$\rho = \frac{\epsilon_1 - \epsilon_2}{e_2 - e_1} \cosh u + \frac{\epsilon_1 + \epsilon_2}{e_2 - e_1} \sinh u, \quad \text{where} \quad e^u = \frac{e_2 - t}{e_1 - t}.$$

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[1] Two curves are homographically divided when there is a one-to-one correspondence between corresponding points.

23. *Curve constructed by three developables.*

Unicursal curves may also be regarded as generated by the points of intersection of homographic planes of three unicursal developables. If three developables are the envelopes of

$$S\rho\phi_1(t) = f_1(t), \quad S\rho\phi_2(t) = f_2(t), \quad \text{and} \quad S\rho\phi_3(t) = f_3(t),$$

the points common to three corresponding planes is

$$\rho = \frac{f_1(t)V\phi_2(t)\phi_3(t) + f_2(t)V\phi_3(t)\phi_1(t) + f_3(t)V\phi_1(t)\phi_2(t)}{S\phi_1(t)\phi_2(t)\phi_3(t)}.$$

The degree of the curve is $n_1 + n_2 + n_3$, where n_1, n_2, and n_3 are the degrees in which the parameter occurs in the expressions for the planes of the developables. Thus, in particular, a twisted cubic is the locus of intersection of three corresponding planes of homographic systems through right lines; here

$$n_1 = n_2 = n_3 = 1.$$

24. *Inverse and pedal curves.*

The inverse of the curve

$$\rho = \frac{\phi(xy)}{f(xy)} \quad \text{is} \quad \rho = -\frac{f(xy)}{\phi(xy)},$$

if the radius of the sphere of inversion is unity. Multiplying above and below by $\phi(xy)$, the equation of the inverse is

$$\rho = \frac{f(xy)\,.\,\phi(xy)}{T^2\phi(xy)}.$$

This is of the form considered in the present Paper, the vector to a point on the curve being expressed as the quotient of a vector binary quantic by a scalar binary.

The pedal of the curve $\rho = \dfrac{\phi(xy)}{f(xy)}$, or the locus of the feet of perpendiculars from the origin on the tangent lines, is easily seen to be given by

$$\rho = \frac{V\dfrac{d\phi}{dx}\,\dfrac{d\phi}{dy}}{\dfrac{df}{dx}\cdot\dfrac{d\phi}{dy} - \dfrac{d\phi}{dx}\cdot\dfrac{df}{dy}},$$

or by

$$\rho = \frac{V.V\dfrac{d\phi}{dx}\,\dfrac{d\phi}{dy}\cdot\left(\dfrac{d\phi}{dx}\cdot\dfrac{df}{dy} - \dfrac{d\phi}{dy}\cdot\dfrac{df}{dx}\right)}{T^2\left(\dfrac{d\phi}{dx}\cdot\dfrac{df}{dy} - \dfrac{d\phi}{dy}\cdot\dfrac{df}{dx}\right)}$$

This curve is in general of the degree $4(n-1)$.

X.

ON THE MELTING POINTS OF MINERALS.

By RALPH CUSACK.

(Plate V.)

[COMMUNICATED BY PROF. G. F. FITZGERALD, M.A., SC.D., F.R.S. F.T.C.D.]

[Read November 9, 1896.]

Hitherto mineralogists appear to have made no efforts towards obtaining the melting points of minerals in their natural state, though the subject is one full of interest, especially in the case of ejected igneous rocks and lavas, which at the time of ejection were subject to no great pressure from the surrounding strata. There is also the theoretic interest attached to such minerals as are the only known representatives of a particular molecular grouping.

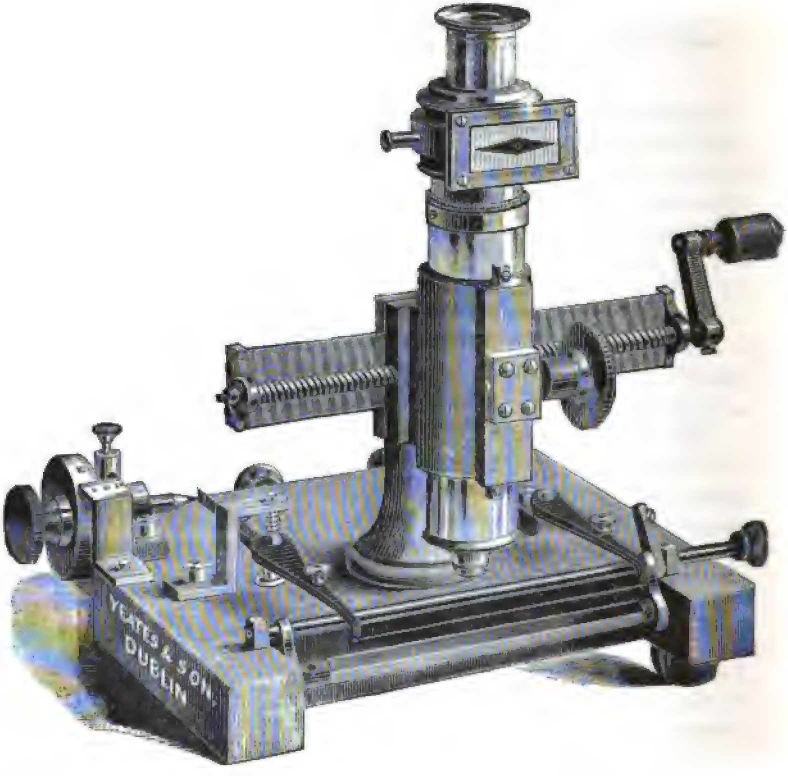
As will be seen from the determinations given further on, melting points afford in many cases an easy and very convenient means of identifying minerals, and may be used for this purpose where only minute quantities of the mineral can be obtained.

The instrument used for the following determinations is Dr. Joly's meldometer—an instrument fully described by him in a Paper published by the Royal Irish Academy.[1] The working of this instrument depends entirely on the expansion of a platinum ribbon heated by an electric current under suitable control. The instrument shown in the accompanying figure[2] is the latest form of the meldometer, as made by Messrs. Yeates & Son (see page 400). It consists of a rectangular piece of slate cut as shown, on which are affixed two forceps, one of which is rigid, and the other free to rotate round a vertical axis, the lower end of which axis dips into a trough of mercury, to ensure good electrical contact. A small spiral spring attached to the vertical axis of the movable forceps, which may be seen at the left-hand side of a figure, serves to keep the platinum ribbon stretched when it is fixed in position. Projecting from the far end of this forceps is a flat steel spring, on the further end of which is fixed a small gold plate with which the platinum point of the micrometer screw, when carried forward, makes contact, which contact

[1] Proc. R. I. Acad. vol. ii., Ser. 3, p. 38, Pl. vi.

[2] Kindly lent by Yeates & Son.

closes the circuit through a galvanometer, not seen in the figure, but situated inside the eyepiece of the microscope. The instrument I used had not the microscope attached to the bed plate, but separate from it; otherwise the instrument was identically the same as that in the figure. The forceps are bent over at the ends, allowing a trough to be raised, and surround the ribbon when in position. This trough can be lowered when necessary, and has been found very advantageous,



as it helps greatly in excluding draughts, which are fatal to accurate working. This trough, however, forms a dust-trap, and will give rise to trouble if not very carefully and frequently cleaned, as the particles of the minerals dealt with fall into it, and the slightest breath of air blows them on the ribbon, which is thereby rendered too dirty, and so useless for further determination. The rheostat used was the same as that employed by Dr. Joly, except that German silver wire was used

in place of the carbon rods. An additional self-working rheostat was introduced for convenience. This rheostat was formed of a carbon rod, about 2 feet in length, enclosed in a glass tube in an upright position; mercury is allowed to flow in from an adjoining vessel and surround the carbon, thereby reducing the resistance. Without any attention being paid to the rheostat, the flow of mercury can be regulated so that the resistance alters either slowly or rapidly as is convenient to the observer.

It would be as well, perhaps, to explain the operation of fixing the ribbon between the forceps, and also how the curve for the expansion of the ribbon is arrived at.

The ribbon used was supplied by Messrs. Johnson & Marthey, and weighs 0·0073 grammes per centimetre, 3·80 inches of which were taken, and clipped at each end at about 30°. The ends thus clipped were fixed in the forceps, and adjusted, so that when a suitable current was passed through, the entire ribbon was uniformly heated.

The ribbon, when adjusted so that it is heated uniformly, is raised to a bright red heat, and left thus for a few minutes; the current is then cut off, and the whole apparatus allowed to cool before calibration is commenced. To calibrate a ribbon the milled head of the micrometer screw is turned until the point of the screw comes in contact with the spring projecting from the other arm of the movable forceps from that to which the ribbon is attached; the number of divisions through which the head has moved are then read off; a speck of silver chloride (the melting point of which is assumed from the determination by Carnelly) is then placed on the ribbon, the current is turned on, and the resistance to the current is reduced by the rheostats in the circuit, till the AgCl is seen to melt, a microscope being used to aid the eye. I may here observe that a small concave mirror was found very convenient for illuminating the substance under observation. The ribbon is not sufficiently luminous of itself until the melting point of cupric oxide is reached. The expansion of the platinum ribbon should be carefully followed with the micrometer screw till the substance melts, and should then be instantly stopped. The point of the screw can be kept in contact with the spring by use of the galvanometer in the eyepiece; this becomes quite easy after a little practice. The number of divisions moved through is again read on the head, and this reading, minus the previous reading, gives the expansion of the ribbon for AgCl. This expansion is then marked off to scale on an ordinate, the temperature at which AgCl is known to melt on another ordinate at right angles; and

thus one point on the curve is obtained, the normal temperature of the room (about 12°) being subtracted from the known melting point of the substance used to calibrate.

A similar process is gone through with each of the other substances used in calibration. I have always found potassium bromide, black copper oxide, and paladium, most convenient. Sometimes a specimen of actinolite was used as coming conveniently between CuO and paladium, but with very slight advantage, as the curve was found always to pass very close to the point thus obtained. Actinolite presents considerable viscosity, and thus has no very definite melting point, but still was useful as a verification of the curve. A numerical example may be useful as to the method of finding the curve of expansion for a ribbon. Thus, in the case of black oxide of copper the reading of the screw-head at starting was 1986 divisions from zero, when the CuO melted ; the head was reading 2329 divisions ; so that 2329 minus 1986 gave the number of divisions, the head moved through between the normal temperature of the room (12°) and the melting point of CuO, so the screw-head advanced 343 divisions. Each of these divisions represents the $\frac{1}{10000}$ part of an inch, therefore the screw advanced through $\frac{343}{10000}$ parts of an inch ; the ribbon when cold measured 3·83 inches.

Dividing 343 by 38,300, the number 0·008955 is obtained. This is plotted on the ordinate to a convenient scale of 0·002 to an inch. Logarithmetic paper can be procured ruled to this scale. The known melting point of CuO, 1055°, minus the temperature of the room, 12°, was plotted on the ordinate at right angles to the temperature scale at the point corresponding to 1043° C. CuO is then marked on the curve at the point corresponding to 1055° C., the temperature at which CuO is known to melt. The first melting in the case of this substance, CuO, must always be used as any subsequent melting is higher. Other substances used for calibration are dealt with in the same manner.

A curve once obtained for a ribbon (see Plate V.), the determination of a melting point is calculated from an observed expansion by calculating the value (of $l_2 - l_1$) divided by l_1, corresponding to the expansion ; then plotting the ordinate and finding the temperature corresponding to this ordinate, and adding the number of degrees corresponding to initial temperature.

A great portion of one's time would be taken up plotting curves if the above operation was necessary for each new ribbon that was used ; as a ribbon very soon gets dirty, the melted particles of the minerals

adhering to it. By cutting a number (say ten) of ribbons at the same time, so as to have them all the same length, and being very careful to have the ends cut away to exactly the same extent, the necessity of plotting a new curve for each ribbon is done away with. After many trials I found that ribbons carefully cut and adjusted properly in the forceps, so that the head of the screw read the same for each ribbon permitted of such being used to the one curve.

The amount the ribbons are cut away at the ends is very important, and great care should be used in seeing that they are cut away an equal amount if a common curve is to be used for a number of ribbons. The best method is to cut each separately on a steel with a very sharp knife, but they may also be marked with a needle point and afterwards cut with a scissors.

When one requires to determine the melting point of a mineral the first step necessary is to reduce that mineral to the *finest* powder; for this purpose a diamond mortar and two agate mortars are indispensable. It has been found most convenient to prepare say ten specimens at a time, and keep the specimens when powdered in little well-corked bottles, as, if the powder gets damp, it is harder to put it on the ribbon so nicely as when quite dry. I have always found the best method of placing the powdered mineral on the ribbon is to use a moderately fine needle. By putting the point of the needle into the powder and then placing the point gently on the ribbon, some of the mineral is found to have remained on the latter. If too much remains the superfluous portion may be removed with a clean camel's-hair brush. The smaller the portion under observation is the easier it is to determine its melting point; especially in the case of minerals that have a tendency to pass through a period of viscosity previous to melting. The specimen should always be placed on the ribbon when cold, and the micrometer should be read every day before starting work, also when work is finished. I never found the ribbon to permanently expand more than the 10,000th of an inch when care was taken not to overheat it. The ribbon should always be allowed to cool to its normal temperature before reading, as otherwise it would not have regained its original position.

The minerals dealt with in this paper are those of very common occurrence, along with such specimens of rarer minerals as could be obtained in their crystalline state, in as pure a condition as possible, to make up a group.

Considerable difficulty arises, dealing with the subject of the melting points of natural minerals, in obtaining authentic specimens.

Fortunately this difficulty is considerably lessened by the fact that only small quantities of minerals are required, and these can often be obtained from a museum specimen without injuring the specimens in any way.

In many cases without a quantitative analysis it is quite impossible to give the composition of a mineral with accuracy. In such cases all one can do is to give the locality from which the specimen was obtained as a clue to possible peculiarities in its composition; although in the exact sense one would not be likely to find many specimens of exactly the same chemical composition even when taken from the same locality.

Small variations in chemical compositions do not appear to effect the melting point seriously. Several specimens of the same minerals from different localities show melting points that vary very little; only about 2 or 3 per cent. as will be seen by the tables at the end. Thus a specimen of augite from Terra del Fuego and one from Vesuvius differed in their melting points only by 12°. That from the former melted at 1187°, and the latter melted at 1199° C.

When one finds that the hardness and specific gravity of two specimens of augite vary very considerably with their composition, it is not surprising to find that their melting points also vary somewhat. But whereas in extreme cases the specific gravity of augite varies nearly 10 per cent., the melting point only varies, as far as observations have been made, 1 per cent. The greatest variation observed is that of Diallage, one specimen melting at 1264°, and another at 1300°. In this case I may have chanced to hit on extreme specimens, for the first specimen melted at 1300°, and the second I tried melted at 1264°, but when the other three specimens I had obtained were determined it was found that they only varied 14°. Diallage is slightly viscous, so has no *definite* melting point. I have to thank Dr. Sollas for his kindness in giving me out of the museum several specimens I would otherwise have been unable to obtain; and I have also to thank Dr. Joly for his kindness in lending me instruments, for many specimens, and for the assistance he frequently gave me.

It would be interesting perhaps to give an account of the behaviour of some of the specimens when on the ribbon.

Actinolite.—Of the four specimens examined, three were of the light green fibrous variety, and one a dark olive green crystal quite destitute of fibrous structure, and yet the melting points differ by only 16°, that of the granular specimen being the lowest; this might be accounted

for by the fact that it is nearly impossible to reduce a fibrous substance to powder; its appearance under the microscope resembles particles of finely chopped hay rather than a dust. Actinolite is viscous, but it is possible to determine a point at which it is decisively melted; in fact all the silicates present a period of viscosity in a greater or less degree, so that none of them can be said to melt at any definite temperature, but one can say a substance is melted at this temperature, and is not at that. The difference between the two temperatures is never more than about 10°, so that leaving a margin of 5° on either side of the temperatures given, the substance may be said to melt within that range, except in very exceptional cases, which are especially mentioned.

Tremolite.—The two specimens were to all appearance similar, and behaved the same as actinolite.

Hornblende undergoes a short period of viscosity which is only perceptible with difficulty.

Diopside.—The specimens examined were all transparent, two were of a pale green, the other was nearly white; their behaviour was similar to hornblende.

Diallage—Different specimens of this mineral varied very much as to their melting points, more so than any other mineral examined, but this has been remarked on elsewhere. The period of viscosity varies with different specimens, and the way the substance is ground was also found to affect the melting point; only after the greatest difficulty was it reduced to a sufficiently fine powder to obtain the results given; the previous results with the same specimens were very much higher.

Augite is not distinguishable from hornblende on the ribbon.

Spodumene behaves rather like the felspars, and has to be reduced to the very finest dust; it bubbles at about 1200° C.

Wollastonite.—Both specimens were white, and presented fibrous structure; their viscosity was hardly observable.

Enstatite.—A specimen of the variety Bronzite was observed to be viscous at about 8° below its melting point, which is slightly more than is the case of most minerals.

Olivine is the most viscous mineral met with; one specimen was viscous at 1323°, and only flowed freely at 1407°, but after careful observation it was found to be melted at 1378°, but to retain a globular form, which was hard to distinguish from the surrounding dust, as only the very smallest particles are *seen* to melt at this temperature. If the larger particles are watched on the ribbon it will be seen that

the side next the ribbon is melted, and that the upper side is not altered, or at least only softened slightly. In some minerals when the under side is melted the rest of the particle is not supported on it, so that it in its turn comes in contact with the ribbon, and is melted when the ribbon is left at the temperature at which the under part was observed to melt, but in the case of Olivine and a few other minerals this is not so; as, when the underside melts, the upper portion is supported on it, and if the temperature is not raised it will stay thus never melting, radiating heat as rapidly as it absorbs it. As this temperature is the same as the temperature at which the minutest particles melt, I have put it down as the melting point in the case of Olivine, and several other equally viscous minerals that behave similarly.

Garnet.—The specimens of Almandine garnet examined were not of any particular interest; they were slightly viscous, and melted at very much the same temperature. One was found at the junction of the granite and the gneiss near Carrickmines; it was transparent and dark red.

Vesuvianite presents no viscosity, and bubbles up at about 1100°.

Epidote changes colour as it is heated and bubbles up at about 1000°; one specimen of epidote was fibrous, and it melted at a higher temperature than the granular specimen.

In *Meonite*, *Nepheline*, *Sodalite*, and *Leucite* nothing remarkable was observed; they were all observed to bubble slightly, except Nepheline, when fused.

The Felspars.—Two specimens of Adularia were examined, both transparent, and melting practically at the same temperature. Adularia bubbles up at about 1230°, which the other felspars have not been observed to do; it can thus easily be recognised. All the felspars are viscous to a large degree; a margin of 15° is allowed from the time the substance is first observed to soften till it melts. The figures given are those at which the smallest particles of the dust were observed to be melted on the ribbon. When melted they look more transparent. This is a very good means of observing when the substance is melted, for then the ribbon looks like a strip of paper with a number of pinholes in it held up to the light, and after a few trials it is possible to catch the temperature at which the pinhole appearance first occurs. Before this temperature is reached, however, the little particles are observed to tumble about the ribbon showing that they are going through a period of viscosity before the melting point is reached. The felspars are not distinguishable from one another by

their behaviour on the meldometer, except Adularia, which bubbles up.

The *Tourmalines* are the most erratic minerals observed, as will be seen from the temperatures given in the tables, ranging as they do over an extent of 90°, a specimen of dark green tourmaline which was quite transparent, having a melting point as high as 1102° C., while one specimen of Schorl from the Wicklow granite melted as low as 1012°, and another at 1018°, a specimen of Rubbellite melted at a temperature nearly intermediate between these, at 1068°; but when the great variety in composition of the tourmaline is considered, the variation in their melting points is not surprising.

The *Oxides* present no peculiarity as far as their melting points are concerned; some are quite infusible, or rather infusible below the fusing point of platinum. Rutile melts at 1560° C., or 60° above the melting point of the paladium, and the melting of Brookite is not distinguishable from it. These very high temperatures are very difficult to deal with, as the glare and heat of the ribbon are very great, and very trying to the eyes. The fact that Brookite and Rutile melt at the same temperature tends to show that the melting points of substances of the same chemical composition are not influenced by the molecular structure or difference of symmetry. Zircon probably melts at about 1760°, as when the platinum fused the Zircon dust was stuck on to the ribbon, and was apparently rounded at the edges as if partially melted. It was not observed to melt under the microscope. The specimen of Uranite was rather earthy, but was the only one obtainable, and perhaps the observation is not very trustworthy. Corundum showed no signs of fusion even at the highest temperature.

Quartz melts easily, but undergoes a long period of viscosity; nearly 20° of a margin ought to be allowed on either side of the given melting point; it was observed to be soft at 1406° C., and only ran freely at 1440°, but was liquid at 1425°, being at this temperature observed to flow like thick glycerine when the temperature was kept constant. When the temperature was very slowly raised it was observed to flow more and more easily till at 1440° it flowed like water.

The *Phosphates* are interesting as they vary a great deal in their melting points. Wavellite being quite infusible, while Vivianite, iron phosphate, is fusible at 1114°. Several attempts were made to obtain the melting point of Turquoise, but with no success. It is certainly infusible at 1500°. A specimen of perfectly transparent Apatite from Switzerland was fusible at 1221°.

Of the *Sulphides*, Stibnites, Galena, and Zinc Blende were easily determined, but some of the sulphides were either decomposed or oxidised immediately on fusion, if not before, so that their melting point could not be satisfactorily determined. Iron pyrites suddenly decomposed at 642°; whether it is fused at that temperature or not it is impossible to say, as the specimens suddenly became a greyish yellow colour, or rather a substance of that colour was suddenly formed on the ribbon. What the substance was could not be satisfactorily discovered, as the quantity was so small that it could only be seen under the microscope, but probably it was sulphur. Galena behaved somewhat similarly, only the substance formed was white. Realgar and Orpiment both changed colour as the temperature was raised, but I noticed that if the temperature was kept constant the colour did not change during the time the temperature remained constant.

The subject of the sulphides is perhaps the most interesting in connexion with the meldometer when the pyro-chemical side is considered, as the charges that take place can be so much better observed on the ribbon under the microscope, than when observed in connexion with the blowpipe. As this Paper deals exclusively with the points of fusion of minerals, very little can be said in connexion with the sulphides, which nearly all appear to decompose at low temperature.

A remarkable phenomenon which still remains unexplained was observed to occur in the case of some minerals just before the point of fusion was reached, and was particularly remarked in the case of CuO.

When the temperature of fusion was nearly reached, it was observed that round a single grain of the substance under observation, a halo had formed, which increased in size as the temperature continued to rise. If the temperature remained constant the substance did not fuse, but the halo continued to increase in size for a considerable period, but very slowly after the first thirty seconds, stopping altogether in about two minutes (this was observed in one case with CuO). One is inclined to think that material from the undersurface of the substance formed some compound with the platinum of the ribbon, and that this, being more fusible than the CuO, flooded out on the ribbon, causing the halo appearance. But what combination could occur between CuO and platinum? Again if the substance was viscous, and a very bad conductor of heat, it might have been caused by the undersurface in contact with the ribbon being melted first, and flowing over the ribbon, which actually occurred in the case of olivine.

This substance is, however, very viscous, whereas CuO has a very definite point of fusion, so this explanation will not account for the case of CuO. The roughness of the fragment of CuO, and the movement and regularity of the halo, appear to negative any explanation depending on the reflection of light. In fact I have not been able to arrive at any satisfactory explanation of the phenomenon.

The meldometer, as will be seen from this Paper, can be used as a high temperature thermometer up to the melting point of platinum, reading with ease to 2° C. In the present instrument no attempt has been made to magnify the expansions of the ribbon; this could best be done by lengthening the arm, especially for a short range, say of 300°, and thus obtain closer readings.

A far more interesting use the meldometer could be put to is that of analysis in place of the blowpipe. Here it would be of enormous advantage—one would have no waste, and could always have the use of a microscope, and use only very small quantities of the minerals. In the meldometer, not only can the reduction or oxidisation of a mineral be observed under the most favourable circumstances, but also the temperature at which such changes take place can be recorded. The meldometer is also much cleaner to work with (and one never gets a red-hot spark into one's eye as is sometimes the case with the blowpipe), and it is very much easier to handle in every respect than the blowpipe. Sublimates can also be very easily obtained with the meldometer, as any one who has read Dr. Joly's Paper,[1] on the "Melting points of Minerals," will have seen. He there describes many of the sublimates he obtained, and also the means used for obtaining them.

It is interesting to consider what the melting points of minerals are influenced by, whether it depends entirely on the chemical composition of the mineral, or if the molecular structure influences it also.

As an example: both rutile and brookite fuse at the same temperature, though of different forms of symmetry; but topaz and kyanite, though nearly of the same composition (some of the oxygen in the kyanite being replaced by fluorine in the topaz), show in the case of kyanite a fusing point of 1090°, whereas topaz is quite infusible. Can the infusibility of topaz be accounted for by the presence of fluorine? It would appear as if the laws of fusion were very complicated.

The following list of the minerals whose melting points have been determined may be of interest. The procedure in arriving at the

[1] *Loc. cit.*, p. 38.

melting point of a particular specimen, once the curve is got, is the following:—First a tiny speck of the mineral is put on the ribbon, then the micrometer screw is adjusted till the point is just in contact with the spring of the arm; the galvanometer will then oscillate if the head be moved the slightest bit back. The contacts can be made so that a movement of the 20,000th of an inch of the point of the screw will make or break the circuit through the galvanometers. This forms a very delicate means of reading the expansion of the ribbon. When the screw is thus adjusted the trough is raised so as to surround the ribbon, and then the microscope can be placed so as to have the speck in the field of view. This is difficult, and it was found convenient to use a pointer of a little piece of platinum wire to find the speck. If the mineral is expected to melt before a temperature of 1000° is reached, a ray of light should be thrown on the speck by means of the mirror previously mentioned; the current is then turned on, and the resistance in the circuit decreased till the mineral is observed to show signs of melting; the screw is kept following the expansion of the platinum all the time, till the substance is observed to melt, then stopped, and the expansion calculated as previously shown. The first determination is generally too high, and at least four or five trials are made before the melting point is satisfactorily arrived at, but generally ten to fifteen are found necessary when dealing with a viscous body. If one knows about the temperature at which the body may be expected to fuse, five or six are, however, generally sufficient. The expansion at each trial is generally less than the previous one, and thus a point can be arrived at, which is the lowest at which the mineral under observation is observed to be fused. One can in a similar way determine the lowest point at which a substance is soft, as when soft it can be seen falling about on the ribbon.

The following example may illustrate this. The mineral was a specimen of Diallage. When cold the ribbon was 3·83 inches long, the head reading 1812 divisions:—

1st	trial,	2276	was reading	of head.
2nd	,,	2284	,,	,,
3rd	,,	2263	,,	,,
4th	,,	2267	,,	,,
5th	,,	2260	,,	,,
6th	,,	2264	,,	,,

I then concluded Diallage was melted at temperature corresponding to 2260 - 1812 ÷ 3·83 = 0·01169 or 1264° C.

By making similar trials I found that the little particles fell about first at a temperature of about 8° lower.

SILICATES.

Bisilicates.

Actinolite (green)—

A. 1288°, Greenland.
B. 1282°, Glenely, Scotland.
C. 1272°, Tyrol.
D. 1275°, —.

Tremolite—

A. 1223°, —.
B. 1219°, Bunbeg, County Donegal.

Hornblende—

A. 1187°, Arendal, Norway.
B. 1196°, Vesuvius.
C. 1200°, —.

Diopside—

A. 1187°, Ala, Piedmont.
B. 1192°, —.
C. 1195°, —.

Diallage—

A. 1264°, —.
B. 1300°, —.
C. 1278°, —.
D. 1284°, —.
E. 1270°. —.

Augite—

A. 1188°, Tyrol.
B. 1199°, Vesuvius.
C. 1187°, Terro del Greco.

Spodumene—

1173°, Killiney.

Enstatite—

1295°. Bronzite.

Wollastonite—

A. 1203°, New York.
B. 1208°, Manta Somoma.

UNISILICATES.

Olivine—
A. 1378°, Vesuvius.
B. 1363°, Vesuvius.
C. 1372°, softens at 1342°, Carthagena, Spain.

Garnet, Almandine—
A. 1264°, —.
B. 1268°, Dublin granite.
C. 1263°. Bohemia.

Vesuvianite—
A. 1024°, Binn.
B. 1035°, Vesuvius.

Epidote—
A. 954°, Portrane.
B. 976°, Arendal, Norway.

Zoisite—
995°, —.

Dioptase—
1171°, —.

Axinite—
995°, Switzerland.

Meionite—
1281°, Vesuvius.

Nepheline—
A. 1070°, Arendal, Norway.
B. 1059°, Vesuvius.

Sodalite—
A. 1133°, Vesuvius.
B. 1127°, Vesuvius.

Leucite—
1298°, Vesuvius.

Adularia—
A. 1168°, Ceylon.
B. 1164°, Switzerland.

Albite—
1172°, Mourne Mountains.

Microcline—
1169°, Binnenthal.

Labrodorite—
A. 1235°, —.
B. 1223°, Basalt, Howth.

SUBSILICATES.

Tourmalines—
A. 1018°, Schorl., Dublin.
B. 1012°, Abs, Norway.
C. 1068°, Rubbellite, Massachusets.
D. 1102°, Dark green.
E. 1013°, yellow.

Cyanite—
1090°, Donegal.

Topaz, infus.

Titanite—
A. 1142°, green, Switzerland.
B. 1127°, pink, Switzerland.

Staurolite—
1115°, Wicklow.

Andalusite—
1209°, —.

OXIDES.

Zircon,	infus.	*Brookite,*	1560°.
Cuprite,	1162°.	*Uraninite,*	1188°.
Zincite,	1260°.	*Corundum,*	infus.
Cassitirite,	1127°.	*Quartz,*	1425°.
Rutile,	1560°.	,,	softens, 1406°.

PHOSPHATES.

Vivianite,	1114°.	*Apatite*—	
Wavellite infus., Cork.		A. 1221°, Switzerland.	
		B. 1227°, Rengrew, Canada.	

SULPHIDES.

Molybdenite,	1185°.	*Galena,*	727°.
*Realgar,**	377° (?).	*Zincblende,*	1049°.
*Orpiment,**	325° (?).	*Iron Pyrites*	642° (?).†
Stibnite—		*Marcasite,*	642° (?).†
A. 518°.			
B. 523°.			

* If Realgar or Orpiment are suddenly raised to the above temperatures they appear to melt before subliming.

† Oxidizes suddenly.

XI.

CONCERNING MARSH'S LIBRARY AND AN ORIGINAL INDULGENCE FROM CARDINAL WOLSEY LATELY DISCOVERED THEREIN. By REV. GEORGE THOMAS STOKES, D.D.

[Read February 8, 1897.]

When Archbishop Benson visited Dublin last September, he paid a visit to Marsh's Library. I met him at the door, and, as we entered, I told him that this was the library once owned by Bishop Stillingfleet of Worcester, and described upon his monument by the great critic Bentley as "a library the like of which was not anywhere else in the world." "Oh, no!" he replied; "this cannot be Stillingfleet's library; because when I was at Hartlebury Castle, the other day, the Bishop of Worcester told me he had Stillingfleet's library there and he showed me some books which once belonged to Stillingfleet." "Well, your grace," replied I, "the bishop may have some few books, the relics of his library, but the corpus or body of Stillingfleet's library, is now before your eyes; and I will show you proofs thereof in various presentation volumes, made to Dr. Stillingfleet by various authors, even before his consecration." And so I did, showing the archbishop, for instance, Cave's "Lives of the Fathers," with the autograph inscription of Dr. Cave, describing Dr. Stillingfleet as "that illustrious and learned man, Canon of Canterbury and of St. Paul's." But Marsh's Library contains much more than Stillingfleet's collection. It is a composite institution. It contains three episcopal libraries, an ordinary clergyman's library, and a portion of another library, the property of a vicar-general. Let me describe it somewhat in detail. First of all, Stillingfleet's library is the basis of the whole collection. Then, there is Stearne's library; and Stearne was the learned Bishop of Clogher. Then there comes Archbishop Marsh's own library, largely composed of Oriental works, Hebrew, Chaldee, and Syriac—though he gave many of such works to the Bodleian. For Marsh was a great Oriental scholar, and is described by a contemporary Oxford divine as "the greatest pillar of Oriental learning in the West since the

time of Ussher."[1] The fourth library is that of the Rev. Dr. Bouhereau, the first librarian of the institution, which completely fills the present reading room of "Marsh."[2] And the fifth library, largely, perhaps, it might be said, entirely composed of manuscripts dealing with Irish history, was the property of that eminent canonist, historian, and Orientalist, Dr. Dudley Loftus, who lived and died in Upper Exchange-street, as it is now called, or as it was then styled the Blind Quay, at the back of Parliament-street. The library thus constituted was for long the only *public* library in Dublin, and continued such down to the earlier part of the present century. The late Dr. Stubbs of Trinity College, not so very many months ago, came into it one day and showed me the Latin dictionary for the sake of which, as he told me, he used to frequent "Marsh's" in the "thirties," and out of which he gathered all the Latin which took him on to fellowship; and, to show the marvellous conservatism of the atmosphere and of the place, he went and put his hand upon it, standing in the very spot where it stood sixty years before.[3] Now, as naturally may be supposed, the contents

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[1] Marsh despaired of Oriental learning in Ireland, and therefore bestowed nearly 1000 codices, Hebrew and Syriac, upon the Bodleian Library. His own private library, which now forms a portion of that founded by himself and called after him, is largely composed of Oriental books. It is curious that Marsh should have so despaired of his own favourite study and its fate in Ireland, seeing that his friend and contemporary, Dr. Dudley Loftus, was a Dublin Orientalist whose fame was, just then, world-wide: cf. a paper by me on Dr. Dudley Loftus in the Journal of the Royal Society of Antiquaries of Ireland for 1890–91, pp. 17–30. Dudley Loftus printed Syriac works here in Dublin more than 200 years ago. I wonder what became of his fount of Syriac type? It can scarcely have been that used in the printing of Dr. Gwynn's learned work on the text of the Apocalypse. A paper on Oriental Scholarship in Dublin since 1600 would be very interesting. Ussher, Loftus, Huntingdon, Marsh, form a goodly succession of Orientalists.

[2] Bouhereau was the first librarian. He was originally a Huguenot physician. He came to Dublin after the Revocation of the Edict of Nantes, and became the pastor of the Conformist Huguenots, who worshipped in the Lady Chapel of St. Patrick's. He was also the first librarian of "Marsh," and was Under Secretary as well to the Lord Lieutenant of that day. He was the ancestor of the family of Burroughs. He was a good scholar, and among his books in "Marsh" is a French translation of Origen against Celsus which he printed at Amsterdam in 1700. This translation is praised both by Mosheim, in his German translation of the same, published in 1745, and by Dr. Westcott, in his article on Origen in the *Dict. of Christian Biography*, vol. iv., p. 122.

[3] The lexicon which had proved thus useful to Dr. Stubbs was Gouldman's "English and Latin and Latin and English Dictionary," published at Cambridge in the year 1669. It had been Archbishop Marsh's own property, as

of Marsh's Library, composed of such materials, are largely ecclesiastical and historical; but they are by no means exclusively so. Ecclesiastics are physicians for the soul; but in ancient and modern times alike, they have magnified their office and loved to be physicians for the body as well; and, in consequence, there is no place where you are so sure of curious "finds" in the region of ancient medicine as in these old ecclesiastical libraries of the seventeenth century; and not in medicine merely, but also in law, ecclesiastical and civil, botany, poetry, music, and various other directions which modern physicians will maintain, come more legitimately under a clergyman's cognizance.

Some time ago I had an American oculist in the library, and I presented him with a treatise on diseases of the eye dating from the days of King Charles I. He looked over it with great interest, and assured me that there were several remedies and drugs there mentioned which are now used as the very latest ideas by American practitioners. While again, if the Bombay Government would only communicate with me, I could easily send them notes from several works giving them the concentrated experience of the physicians of England, France, Spain, and Italy, concerning the plague in the days of Charles II.

The poet, however, tells us that "our little systems have their day"; and so it was with "Marsh."

It had its day more than half a century ago, and then served its generation well as a public library; but it has been cut out by other public libraries, which have since sprung into existence and are more accessible, while the mother of all the really public libraries in Dublin has been left stranded up under the cathedral shadow, and stranded so completely that I found on my appointment as its "keeper" that the number of visitors and readers for the previous twelve months had been exactly two.[1] Well, we are better now. The learned treasurer of this Academy and even some stray members of the Council, at times appear there, and prove the magnitude of the resources of which I have spoken. The wise man, however, assures us that God has made all things double, one against another, and that He has made nothing unequal; and so it has been with "Marsh's."

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proved by the motto which he inscribed in all his books, πανταχῇ τὴν Ἀλήθειαν. It is very useful to young students, because it marks all the quantities both of proper names and of ordinary words.

[1] Perhaps nothing will show the depth of ignorance prevalent still about "Marsh," as the fact told me by several persons of late that the very police who live next door to the library in the ancient Archiepiscopal Palace have assured inquirers that they did not know where it was, and had never heard of it. The constables who said so must have been comparatively young members of the force.

The very neglect into which the library has fallen has had a counterbalancing advantage. It has had, for instance, a marvellous preservative influence upon it. Nothing has been more destructive of ancient work than the keen desire for restoration which has seized like a fever upon the public mind. The first thought which an ancient building suggests now-a-days is this—"Here we have something to restore"; and, under the restorer's hand, much genuine ancient work has disappeared which the ignorant contempt and neglect, and whitewash of our forefathers handed down to us. So it has been with "Marsh." It was for long years handed over to dust and oblivion; but dust and oblivion have preserved its treasures, while knowledge and use would have brought literary thieves and literary loss in their train.[1] And so it is that in Marsh's Library you will find books still which even the British Museum does not contain, and certainly would much desire to possess, a specimen of which I now desire to bring under your notice. During the Christmas holidays I happened to be reading the 2nd edition of Maskell's great work, called *Monumenta Ritualia Anglicana*, originally published about 1845, and re-published, in 1882, by the Clarendon Press. That work is very interesting to a librarian, a bibliographer, or a ritualist, in the technical sense of that word, but is uninteresting to any one else. It goes into great details about ancient service books, whether manuscript or printed, specially of the use of Sarum, the use which prevailed in Irish churches from 1200 to, say, 1550. Mr. Maskell always speaks as if the only places where you could see specimens of those distant times were the British Museum or else the libraries of Oxford, Cambridge, and Lambeth. He makes an occasional mention, but very "occasional," indeed, of the Dublin University Library as a place where some few ancient copies are preserved, but ignores every other Irish institution. I must confess that thereupon the fire kindled, and I thought within myself—well, I will look and see what "Marsh" can do in this matter. Let us see whether the British Museum, and Oxford and Cambridge, are the only places which possess ancient printed copies of Sarum Service Books. I at once set to work, and found in "Marsh," between

[1] During the period when the library was much used a large number of the most valuable books were stolen. The thieves showed great discrimination in the books which they abstracted, as they were always rare and even unique editions. This fact led the Governors, about 120 years ago, to order that no one should read save in the reading room, and that every reader should be searched on his departure. This order is still, in its original shape, exhibited on the walls of the library, dated Oct. 14th, 1779.

Breviaries, Missals, Processionals, Manuals, Psalters, and such like, fully a dozen at least original Sarum and York Service Books, some of which, like the one I now exhibit, are not found in any of the great collections to which alone Mr. Maskell referred.[1] Here now you may fairly ask me how comes it to pass that "Marsh's Library" is so rich in these ancient service books. The best explanation of that richness will be found in the original constitution of that library, as I have already explained it. Its main constituents are three great episcopal libraries. The three owners were wealthy men for their times. Two of them, Marsh and Stearne, were old bachelors—and all three were book-lovers. All three, too, belonged to the seventeenth century, when the great Rebellion and its troubles had broken up old households and flung large libraries on the market; and hence the owners of these libraries had unique chances of picking up rare old works, of which they diligently availed themselves.[2]

Now amongst the books to which I first turned, when I wished to find out the riches of "Marsh," were those formerly belonging to Dr. Stearne, once bishop of Clogher, and, previous to Swift, Dean of St. Patrick's.[3] There I found a Psalter according to the use of Sarum

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[1] The reader will see at the end of this paper a tolerably complete list of all the ancient printed English liturgical works still in "Marsh." Some of them contain most interesting manuscript notes and notices.

[2] In the same way the Irish Land Acts and Irish Land troubles have already brought some rare old books into the Irish market. Twenty years ago I picked up in Cork an uncut copy of Du Pin's "Ecclesiastical History" in the original Dublin edition of 1724, printed by George Grierson, at the sign of the Two Bibles, in Essex-street. The ancestor of the modern owner had been a Dublin judge of that period. He was of literary taste, which was more than could be said for his descendants, and he subscribed for this great work in 3 folio volumes. And there in his house it lay unnoticed till necessity forced its sale. A short time since I picked up again, for a few shillings, a copy of a celebrated mediæval work, the "Pupilla Oculi" of John De Burgh, composed about 1300 and printed in 1504. This work was the theological handbook of the English clergy from 1300 to 1560.

[3] Stearne was a learned man and an antiquary of no mean powers. He was, like the late Bishop Reeves, an indefatigable scribe. He was connected through his grandfather with Ussher, while his ancestors had been Meath clergymen during the whole of the seventeenth century. Stearne copied Ussher's and Dopping's Surveys and Records of Meath and left them to Marsh's Library, where they now remain. They are full of information about the parishes of Meath in that period of obscurity which followed the Reformation. The "Stearnes" often spelled their name "Sterne." Thus, this very month of March, the Rev. Dr. Groves presented "Marsh" with a copy of a work, "A Defence of the Protestant Faith," by Enoch Sterne, LL.D., Clerk of Parliament, Dublin, 1755. He was a member of the same family once seated at Garrycastle, near Athlone. The name is, however, always written "Stearne" in the Matriculation Book of Trinity College.

and York, together with the Latin hymns in daily use in these churches. Now these ancient English Psalters require a word of explanation. They are no longer in use either in this country or on the Continent, having been superseded by changes in the service books made by the Pope subsequent to the Council of Trent. They are not what are now called Psalters in the Church of England. Maskell defines them as "books in which the Psalms are contained, divided into certain portions for matins and the hours, so as to be gone through in the course of a week." The Sarum and York Psalters were simply the Prayer Books of the educated laity in the year 1500; and as such they are generally like modern Prayer Books, convenient in size, either small octavos, or else smaller still. Maskell states that there are three of these Sarum and York Psalteries, or Prayer Books, in the Museum Library; one printed at Paris in 1516, for much of English printing was then done at Paris and at Rouen; another printed at Antwerp in 1524; and a third, dated in 1529, without any colophon. *But not one of these Sarum and York Prayer Books was printed in England.* Now the very first book I took down from Bishop Stearne's collection was this unique volume, "A Psaltery and Hymnery according to the use of Sarum and York," dated in the year 1524, *and printed in the city of London.* All the Sarum Prayer Books in the British Museum mentioned by Mr. Maskell were printed *abroad*, while this one in "Marsh" was printed in *London.* But this was not the only curious and interesting point about it. The colophon, or imprint, of this book was, as usual in that age, at the end of the book, and on the very last page, instead of on the title-page, as is the present custom. This colophon ran as follows: "Explicit Psalterium cum Antiphonis dominicalibus et ferialibus, suis locis insertis, una cum hymnis Ecclesiae Sarum. et Eboracen. deservientibus. Impressum in civitate London. per Richardum Pynson regis impressorem Anno Domini MDXXIIII."

Now let me give you a brief description of this unique Prayer Book. It is an octavo volume in the original binding of embossed sheepskin. The title-page consists simply of the words "Psalterium cum Hymnis," underneath which are the letters R. P., being the initials or device of the printer, Richard Pynson. The contents of the book I need scarcely refer to, as they are too strictly theological for this Academy. There are some points, however, of general interest to which I may briefly refer. The Calendar prefixed to the book is an interesting specimen of the method of computing time in the early sixteenth century, which has, indeed, in more ways than one left its impress upon modern life and practice. The number of days is appended to the name of each month, and the length of the nights in

each month is duly given. Some few Celtic saints—St. Brigid, St. Patrick, St. Petroc, St. David—are commemorated, but they are very few indeed. Then comes the Psalter, followed by the Canticles from the Old and New Testament, and the Te Deum, where a rubric is added, stating that this hymn was said by some to have been composed by St. Ambrose and St. Augustine at the baptism of St. Augustine; but that this was a mistake, as it really was composed by St. Nicetus, of Treves, as Cassiodorus declares in his work about the Institution of Holy Scripture.[1] This statement gives us a glimpse of the condition of historic knowledge at that time, as Cassiodorus lived a clear hundred years before St. Nicetus, so that he must have been a prophet to be able to tell what Nicetus would compose a hundred years after Cassiodorus had died. However interesting the book may be on these questions, they have more attraction for a Historical Society than for such a body as ours devoted to literary subjects from an antiquarian point of view. Looking at the Psaltery from that standpoint, the most curious topic is its printer, Richard Pynson.[2] He was, as I have said, the earliest printer in the city of London, as printing was first established by Caxton in Westminster, where Caxton was succeeded by his son-in-law, Wynken de Worde.

Richard Pynson and De Worde were fellow apprentices to Caxton and great friends all through life. Pynson established his printing press at Temple Bar, where he printed his first work in 1493, under the title of "The Dialogue of Dives and Lazarus upon the Ten Commandments," which ought to be very useful and edifying reading for the wealthier members of this Academy, though we can scarcely be quite certain about the authenticity of the reports.[3] Three years later he printed there the first classical work published in England,

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[1] Cf. the article on St. Nicetus (3) 25th Archbishop of Trèves in the *Dict. of Christ. Biog.* iv. 38.

[2] All books dealing with the history of printing, such as Palmer, Mattaire, Cotton, Humphreys, Blades, are full of Pynson; cf. the article on him in the *Dictionary of National Biography*.

[3] Pynson also printed the "Ship of Fools," in which the first fool was the "Book Fool" or Bibliomaniac, who is thus represented:—

> "I am the first fool of the whole navy,
> To keep the pompe, the helme, and eke the sayle,
> And this is my minde, and this one pleasure have I
> Of books to have great plenty and aparyle,
> Yet take no wisdom by them; nor yet avayle."

He has them only for show and for their fine bindings.

which was the "Comedies of Terence." From that press he continued for forty years to pour forth numerous books of every sort and condition, among which was the "Booke of Cookery" in 1500, and the first edition of Henry the Eighth's work against Luther a short time before he printed this Prayer Book under our notice. You will observe, too, in the colophon of it, he calls himself the king's printer, thus correcting a mistake made by Mr. Maskell, who states that he was not appointed king's printer till the death of Rastell, in 1536, the brother-in-law of the celebrated Sir Thomas More, who up to that time, held the post. This colophon shows that Pynson was appointed some twelve years earlier at least.[1] But I have reserved to the last, the point for the sake of which I have called the attention of this Academy to our Sarum Psalter. In proceeding to examine this old book, I had a keen eye to the advice of Mr. Bradshaw, about closely scrutinising the linings of the binding, as in them Mr. Bradshaw made some of his own most curious discoveries. The binders of the early days of the sixteenth century had to get linings for their book covers, and as manuscripts were then plentiful they often used up an old manuscript which, then regarded as useless, is now of untold value and importance. Well! pasted inside the front cover I found a printed document which I proceeded to examine and found to be an indulgence from Thomas Wolsey and Laurence Campeggio, soliciting liberal alms for the completion of the north porch and chantry chapel of Hereford Cathedral.[2] The document was evidently a pew bill which had been dispersed through the church in modern fashion, which some pious Christian had fastened, nearly four hundred years ago, inside his Prayer Book, for future use, and there it lay till I found it on the 18th day of last January. I shall now proceed to give a brief abstract of it, but inasmuch as the original owner of it seems to have used the book a good deal, the document has been cracked and torn right through from top to bottom, rendering the meaning at times very difficult to make out. The document which is about 8 inches long by 5 inches broad,[3] proceeds thus—"Be it knowen to all cristen people

[1] Humphreys, in his "History of Printing," tells us that Pynson died in 1530. Rastell may have been appointed on Pynson's death.

[2] Hereford Cathedral has, in the past, owed a good deal to such documents. The bull of John XXII. canonising Bishop Thomas Cantelupe seems to have touched upon this topic; cf. Dean Merewether's pamphlet on the condition of Hereford Cathedral, A.D. 1841.

[3] A similar document of the same period was found by Mr. French in Trinity

that there is a porche of the Cathedral Church of Hareforde builded in honour of our Lord through oblacion and Alms of Christen people that have had confluence unto the most reverent fathers in God, Lord Thomas Legate of the Apostolic see of Rome, Archbishop of York, and Primate of England, and Laurence Compegus also Legate of the Pope of Rome."

The document then goes on to state the desire of these two dignitaries for the completion and due furnishing of this chapel, in order that the "Chapell Preste" there singing for the time being, might have every due convenience for his sacred office, and then grants to every one duly contributing to this object and confessing in the said chapel and performing certain other specified religious duties upon Christmas Day, St. Ethelbert's Day, the feast of St. Thomas of Hereford,[1] and certain other suitable feasts, an indulgence of one hundred days; and further announces that the Archbishop of Canterbury, the bishops of London, Salisbury, Coventry, and Lichfield, the bishops of Hereford, Rochester, Bangor, Llandaff, St. Asaph, St. David's, and curiously enough, Thomas Bishop of Leighlin, had agreed to add forty days' indulgence to every such person who thus qualified. Now there are special points of interest in this indulgence of which I have merely given an abstract. The first is the local one for ourselves. What

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College more than twenty years ago. It is some ten years or so older than Wolsey's "Indulgence," and is in Latin, not English. It is printed in much the same style. It can be inspected in the glasscases in the Long Room of the College Library.

[1] The two feasts of St. Ethelbert and St. Thomas of Hereford were specially observed in the cathedral of Hereford, which was dedicated to the Blessed Virgin and to St. Ethelbert. Ethelbert was king of the East Angles, and was murdered by Offa of Mercia in A.D. 794. He was buried at Fernlega, afterwards Hereford, where a miraculous image celebrated his fame. (See the Article by Dr. Stubbs on Ethelbert (3) in the *Dictionary of Christian Biography*). Ethelbert's feast was celebrated on May 20th. St. Thomas of Hereford was the special local saint. He had been Thomas Cantelupe, Bishop of Hereford. He died with a great reputation for sanctity in 1282. His fame as a miracle worker was widespread. The possession of his relics was a source of great wealth to the cathedral. See more about him in Bishop Swinfield's "Household Roll" and its notes, p. clxxxiii, published by the Camden Society in 1855. His feast was celebrated on Oct. 2nd. He was canonised by Pope John XXII. in 1320, upon the petition of Bishop Swinfield, supported by Edward II. He was, even before his canonisation, a very popular saint in England. Surius tells us, in his *Lives of the Saints*, that more than sixty persons had been raised from the dead at his tomb. In Swinfield's *Roll*, p. *l*, we learn that Edward I. gave the greatest proof of his belief in Cantelupe's powers; for when one of his favourite hawks was ill, he sent an offering for him to Cantelupe's shrine. He is one of the saints who have been Lord Chancellors of England.

brought the Bishop of Leighlin there amongst these English and Welsh bishops, and who was he? Well, Ware will tell us that he was Thomas Halsey, Bishop of Leighlin from A.D. 1515 to 1521. He was an Englishman, and never once saw his diocese in the centre of Ireland. He was appointed Bishop of Leighlin by the influence of Archbishop Baimbridge, Wolsey's predecessor in York, who was just then acting as Ambassador for Henry VIII. in Rome, when the see of Leighlin fell vacant. Halsey was an Englishman in high office at the Vatican, was Prothonotary for Ireland, and Penitentiary for the English nation in Rome. He was a great favourite with Archbishop Baimbridge, and the Archbishop's influence secured his appointment. He never saw or visited his Irish diocese; but managed it through his deputy and Vicar-General, Charles Cavanagh, Abbot of Duisk, and then dying in London, in the year 1521, was buried in the Savoy.

The second point of interest about this Indulgence is its date. If the Bishop of Leighlin is mentioned in it as granting an indulgence, it is clear that it must have been issued before his death, which took place, as I have now said, in 1521. This seems contradicted by two facts: (1) Campeggio is mentioned in it as legate, and he notoriously came to England in 1528 as special Legate of the Pope in the matter of the divorce of Henry VIII.; (2) The date of the Prayer Book stated in the colophon is 1524. This would seem to prove that this indulgence was issued, in the year of Campeggio's residence, about that question of divorce, which Mr. Brewer's great work, "Letters and Papers of Henry VIII.," states to have been from September, 1528, to about the same date in the next year. But then comes a difficulty. If this indulgence was issued in 1528 or 1529, how do there appear in it the names of several bishops like that of the Bishop of Leighlin, who had been dead several years? Could dead bishops grant indulgences to living men? But the Bishop of Leighlin, too, is not the only difficulty if we date the Indulgence in 1529. Richard Fitzjames, Bishop of London, is named in it; and he died seven years before, in January, 1521. Edmund Audley, Bishop of Salisbury, is mentioned; and he died in 1524, five years before.[1] William Attwater, Bishop of Lincoln, is named; and he died in 1520. These difficulties led me

[1] Audley was succeeded by Campeggio himself as Bishop of Salisbury, and yet he does not give himself that title in the Indulgence. Henry VIII. took such a fancy to Campeggio on his first visit to England, that he bestowed on him the see of Salisbury when it fell vacant, which brought with it a splendid palace in Rome: cf. "Campeggio's Life," p. 164. Campeggio was made a cardinal in 1517: cf. Godwin's *Praesules*.

to seek another solution. This was not Cardinal Campeggio's first visit to England.[1] He came here and spent a year, in 1518 and 1519, striving to induce Henry VIII. to join the Pope and the other Christian princes of Europe in a crusade against the Turks, in defence of Hungary, giving him a conditional promise, if he did so, of the title, subsequently bestowed for quite a different reason, of "Defender of the Faith." He also utilized his spare time, in conjunction with Wolsey, in striving to introduce extensive disciplinary reforms amongst the English clergy; and a reference to this πάρεργον on Campeggio's part we find in the words of the Indulgence, which speaks "of the great confluence of Cristen people unto the most reverent fathers in God, Cardinals Wolsey and Campeggio." But then you may say, what about the date of the Prayer Book, 1524? Does not that prove that the Indulgence must have been later? My solution, simply, is: the Indulgence was printed and dispersed in Hereford Cathedral in 1518. It lay there for some years, and then, after the Psalters or Prayer Books were printed in 1524, by Pynson, some clergyman, perhaps, took up a copy, and, wishing to preserve it for future reference, stuck it into the front of his book, where I found it. Our Indulgence has, then, this great historic interest. It is a sample of the Indulgences issued by Tetzel for the rebuilding of St. Peter's, which caused, just at that time, such a storm against papal authority; and, therefore, is a specimen of a document issued at least fifteen years before there was any rumour of religious differences in England, and, as such, occupies a unique position, so far as I know, amongst the remains of the past, in *Irish* libraries at least. I did intend to call your attention to some other documents of interest as regards Dean Swift and some other topics; but, as I think it is far better to send the Academy away longing rather than loathing, I propose to defer the consideration of them to some future occasion.

The following is a complete list of the Sarum books in Marsh's Library, so far as we have been enabled to identify them up to the present:—

I. Missale ad Usum Sar. Paris, F. Regnault, A.D. 1531.
Iterum, Rothomagi (Rouen), 1554.

II. Psalterium cum Hymnis Sar. et Ebor.. Lond., R. Pynson, 1524.
Iterum, Psalterium MS. Saec. XIV.

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[1] See Ligorius, in his "Life of Cardinal Campeggio," pp. 160–164: Paris, 1678. Ligorius was a great friend of the Campeggio family, which had produced many distinguished lawyers at Bologna in the fifteenth century.

III. Portiforium seu Breviarium Sar. 8vo. Paris, F. Regnault, 1555. Iterum, pars æstivalis tantum, ad Us. Sar.

This is a large 8vo edition. Its title-page and Colophon are inconsistent. The title-page is dated Londini, 1555. Its Colophon is dated Paris, F. Regnault, 1535. I suppose the explanation is that Regnault printed a large edition in 1535. During the latter part of the reign of Henry VIII. the sale fell off. When Mary ascended the throne, that sale revived. Regnault stuck in a new title-page, and sold off the old edition, and at once went to press with a new and much handsomer edition of the Sarum book.

IV. Processionale ad Us. Sar. Lond., 1555.

This volume has on the last page a Latin inscription which plainly represents the feelings of the Ecclesiastical owner towards Edward VI. and his party. It runs thus: "This book pertains to the Parochial Church of St. John-super-Sore in the year one thousand five hundred and fifty-three, being the first year of Queen Mary, to whom may God grant the years of Methuselah, and more than that, &c. John Drury, Vicar." Fronting the title-page a Latin hymn is written, and on one of the fly-leaves the name of the owner in 1634, Robertus Apriceus (Ap-Rys). Drury's inscription seems inconsistent with the Colophon.

V. "Horæ B.V.M. Sec. Us Sar." Paris, F. Regnault, 1519.

Whose name and device are on last page; but the Colophon says it was printed by Nicolas Hickman, at the expense of Francis Byrckman, of Cologne. It is beautifully ornamented with pictures.

VI. Martyrologium Sar. London, 1526, Wynken de Worde.

This is Whitford's translation of the Martyrology of Sion, lately reprinted by the Bradshaw Society.

VII. Manuale ad Us. Sar. Rothomagi (Rouen), 1554.

VIII. Postilla ad Us. Sar.; or, Exposition of the Epistles and Gospels for the whole year. London, 1509.

Printed, as the Colophon tells, by Julianus Notarius, Bookseller and Printer, at Temple Bar, at the Sign of the Three Kings.

"Expositio sequentiarum et Hymnorum totius Anni Sec. Us. Sar."

Printed by Wynken, or Wynandus de Worde, A.D. 1515. Original stamped binding. The Colophon, which calls it "Prosarum," tells us that Wynken de Worde was then living in the parish of St. Brigid, Fleet-street. The "Expositio" is bound up with some works of St. Chrysostom on the monastic life, addressed to his friend Stagirus; his Sermon on the Dignity of the human Origin and the prophecies of Julianus of Toledo. Some of these were translated by an Abbot Ambrose, dedicated to the Emperor Sigismund, and printed in the town of Alost, in Flanders, by Theodore Martin, who introduced printing into Belgium in 1473: cf. Mattaire, *Annal.* i. 106.

Iterum: Lond. 1515, Wynde de Worde. In the Colophon it is called Prosarum Sec. Us. Sar.

IX. Primer according to Sarum use.

Upon the title-page occurs the following:—"This Prymer of Salysbery use is set out a long wout ony serchyng, with many prayers and goodly pyctures in te kalender in the matyns of our lady in the houres of the crosse, in the vii psalmes and in the dyryge. And be newly enprynted at Rowen 1538."

Printed by N. Le Kour.
Published by F. Regnault, Paris.

Original binding and many pictures. The spelling is curious.

P.S.—No. IV., as above, is a Processional which seems to me on further investigation to belong to York, not to Sarum. In the front of this book is a short MS. Service with brief rubrics beginning:—

Sacerdos dicat hunc versum sequentem "En rex venit mansuetus tibi Syon; filia mystica humilis, sedens super animalia, quem venturum jam predixi lectio prophetica."

In another book there occur the following notes, showing that the worthy owner at times used his book for secular purposes:—

"Item I shoulde (sold) a black Hoggehrele for 4*s*. 3*d*."
"Item I shoulde thre shepe (sheep) for 15*s*. 4*d*."

Royal Irish Academy.

GENERAL ABSTRACT OF THE ACCOUNTS

FROM

1st April, 1896, to 31st March, 1897.

GENERAL ABSTRACT OF THE ACCOUNT OF REV. MAXWELL

FOR THE YEAR ENDING

RECEIPTS.	£	s.	d.	Total of each Class. £	s.	d.
Balance from last Year,	9	8	6	9	8	6
PARLIAMENTARY GRANTS:—						
General grant in aid,	1500	0	0	1500	0	0
[For Treasure Trove Account see below.]						
MEMBERS' PAYMENTS:—						
Entrance Fees,	63	0	0			
Annual Subscriptions,	273	0	0			
Life Membership Compositions,	64	1	0	400	1	0
PUBLICATIONS SOLD:—						
Transactions and Cunningham Memoirs,	36	17	6			
Proceedings,	4	2	10			
Irish Facsimiles,	50	15	0			
Todd Lectures, and Irish MSS. Series,	12	4	3	103	19	7
ANNALS OF ULSTER:—						
Refund by Government,	113	17	6	113	17	6
INTEREST ON INVESTMENTS:—						
Life Composition—2¾ per Cent. Consol. Stock,	108	0	3			
Cunningham Bequest—2¾ per Cent. Consol. Stock,	70	10	8			
Geological Illustration Fund—2¾ per Cent. Consol. Stock,	11	11	4	190	2	3
				£2317	8	10

TREASURE TROVE

	£	s.	d.
Balance from last year,	328	19	11
Grant 1896–7,	100	0	0
	£428	19	11

TODD MEMORIAL

	£	s.	d.
Balance from last year,	1	2	6
Interest on investments,	41	13	4
	£42	15	10

I certify that the above account is correct, according to the best of my

ACADEMY.

I. CLOSE, TREASURER OF THE ROYAL IRISH ACADEMY,

31ST OF MARCH, 1897.

PAYMENTS.	£	s.	d.	Total of each Class. £	s.	d.
For SCIENTIFIC AND LITERARY PURPOSES:—						
Scientific Reports,	100	0	0			
Library,	338	6	4			
Irish Scribes,	78	0	0			
Printing Preface and Index of Annals of Ulster,	208	9	8			
Do. Yellow Book of Lecan,	28	2	10			
Purchase of Irish Manuscripts,	85	7	6			
Printing Transactions and Proceedings and Cunningham Memoirs,	497	10	3	1335	16	7
„ **ESTABLISHMENT CHARGES:—**						
Salaries,	369	0	0			
Wages and Liveries,	224	19	6			
Furniture and Repairs,	9	10	9			
Fuel and Gas,	60	10	3			
Insurance and Law Expenses,	20	14	6			
Stationery,	10	2	4			
Printing (Miscellaneous),	41	11	5			
Postage,	15	9	4			
Freights, Incidentals, and Contingencies,	34	18	8	786	16	9
„ **ANNALS OF ULSTER:—**						
Paid on Account of Editing and Printing Vol. IV.,	113	17	6	113	17	6
„ **INVESTMENTS (CAPITAL):—**						
(see below)	64	1	0	64	1	0
„ Balance to Credit,	16	17	0	16	17	0
				£2317	8	10

	Stock Bought. £	s.	d.	Description.	Total Stock. £	s.	d.
Life Membership Compositions,	57	5	5	Gov. 2¾ Stock,	4181	17	11
Cunningham Fund,	—	–	–	Do. do.	2653	9	9
Geological Illustration Fund,	—	–	–	Do. do.	435	7	4
Todd Memorial Fund,	35	15	3	Do. do.	1602	17	6

ACCOUNT.

	£	s.	d.
Antiquities purchased,	419	1	0
Balance to credit,	9	18	11
	£428	19	11

ACCOUNT.

	£	s.	d.
Purchase of £35 15*s.* 3*d.* Government 2¾ per Cent. Stock,	40	0	0
Balance,	2	15	10
	£42	15	10

knowledge and belief.—Maxwell H. Close, *Treasurer, R.I.A.*—

[*For Auditors' Report see next page.*

AUDITORS' REPORT.

We have examined the above General Abstract, and compared the Vouchers for the details of the several heads thereof, and find the same to be correct, leaving a Balance to the credit of the Academy's General Account of Sixteen Pounds Seventeen Shillings, and to the Treasure Trove Account of Nine Pounds Eighteen Shillings and Eleven Pence, and to the Todd Memorial Account of Two Pounds Fifteen Shillings and Ten Pence, making in all a Balance of Twenty-nine Pounds Eleven Shillings and Nine Pence.

The Treasurer has also exhibited to us Certificates in respect of the invested *Capital*, showing that the amounts of Stock standing in the name of the Academy were Two Thousand Six Hundred and Fifty-three Pounds Nine Shillings and Nine Pence, $2\frac{3}{4}$ per Cent. Consolidated Government Stock, Account A, being the Capital of the "Cunningham Fund"; Four Thousand One Hundred and Eighty-one Pounds Seventeen Shillings and Eleven Pence, $2\frac{3}{4}$ per Cent. Consolidated Government Stock, Account B, being Capital derived from Life Compositions; and Four Hundred and Thirty-five Pounds Seven Shillings and Four Pence, $2\frac{3}{4}$ per Cent. Consolidated Government Stock, Account C, being the Capital of the Geological Illustration Fund. Like Certificates have been exhibited to us showing a sum of One Thousand Two Hundred and Nine Pounds Eighteen Shillings and Four Pence, $2\frac{3}{4}$ per Cent. Consolidated Government Stock, in the Court of Chancery, and a sum of Three Hundred and Ninety-two Pounds Nineteen Shillings and Two Pence, $2\frac{3}{4}$ per Cent. Consolidated Government Stock, standing in the names of Trustees, which together form the Invested Capital of the "Todd Memorial Fund."

(Signed), W. REYNELL, HENRY KING, *Auditors.*

10th May, 1897.

CONTENTS.

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XII.

ON THE ORIGIN OF THE EUROPEAN FAUNA. By R. F. SCHARFF, Ph.D., B.Sc., F.Z.S., Keeper of the Natural History Collections in the Dublin Museum of Science and Art.

[Read November 9, 1896.]

Two years ago I communicated to the Royal Irish Academy a short report on the origin of the Irish Land and Freshwater Fauna (76*a*).[1] I then stated that a careful study of the Irish Fauna would enable us, not only to prove the former existence of a land-connexion between Ireland and Great Britain, but also to approximately ascertain the time of its arrival from the continent of Europe. I showed that the Mammals of Ireland, both recent and extinct, and also the Mollusca were perhaps more serviceable in a research of that nature than other groups of animals. At the same time I emphasized the importance of a study of the freshwater fishes in elucidating the extent of the land-connexion.

The range of the species of Coregonus in the British Islands and that of the Chars, which I referred to, seemed to indicate the former existence of a fresh-water lake between England and Ireland. Professor James Geikie has since pointed out to me that he had long ago come to the same conclusion on purely geological grounds (35 *b*, p. 512), though, as we shall see further on, he assumes that the fresh-water lake came into existence at a time when, according to my opinion, it must have already been converted into an arm of the Atlantic. At the end of my report, I mentioned that, so far, my inquiries into the origin of the Irish fauna had led me to the following conclusions: "Ireland was in later Tertiary times connected with Wales in the south, and Scotland in the north, whilst a freshwater lake occupied the present central area of the Irish Sea. The southern connexion broke down at the beginning of the Pleistocene Period, the northern connexion following soon after. There is no evidence of any subsequent land-connexion between Great Britain and Ireland."

[1] *Vide* Bibliography at end.

I have not changed my views since,[1] and hope to be able to show in the subsequent pages that I have very strong evidence for this belief. From my previous remarks on the land-connexion, it is evident that the whole of the Irish fauna therefore must have reached Ireland at the commencement of or before the Glacial Period, and survived the latter in that country.

As the origin of the Irish fauna forms the key to the solution of the problem which I propose to discuss, I intend to deal with it more fully than has been done, before entering on the larger subject of the general European fauna.

The researches which are at present being carried on into the Irish fauna and flora by a Committee appointed by the Royal Irish Academy, have established many facts possessing important bearings on the origin of the plants and animals of Ireland, and these facts have been of much use to me in the preparation of this Paper.

Professor Sollas has been good enough to discuss the whole subject of the origin of the European fauna with me, and I should like herewith to express my gratitude to him, as he has induced me to reinvestigate some of the more important issues raised in this essay.

I have also to acknowledge the kind assistance rendered me by Prof. Giglioli on Corsican Mammals, and by Prof. O. Boettger, Prof. Penck, Prof. Depéret, Prof. Suess, Prof. Boyd Dawkins, Prof. Haddon, Messrs. Carpenter, Praeger, Welch, M'Ardle, Halbert, and many others for information on various subjects.

The Divisions of the Irish Terrestrial Fauna.

A careful study of any section of the Irish fauna and flora reveals the fact that there are in it minor groups of animals or plants which on the Continent live altogether in the north, some which inhabit exclusively the south, and others again to which no particular limit of range can be assigned. Besides these there are a small number of species peculiar to Ireland, which we need not consider here. Taking the fauna as a whole, we find that we can establish three distinct divisions as follows :—

I. Animals with a wide distribution,
II. ,, with a Northern distribution.
III. ,, with a Southern distribution.

[1] It will be seen later on that my conclusions point to the Glacial Period being of much longer duration than is usually assumed, that in fact the earlier part of it, corresponds to what is now generally looked upon as later Pliocene. According to this view the migration of the bulk of the Irish fauna would naturally have taken place during the Glacial Period.

I. Those of the first division comprise all animals whose origin is obscure. Many of them may at some time or other have been introduced by man, such as the rat or the mouse. The majority, however, I think, are of great antiquity, and their origin dates from some remote geological age. They appear to be mostly indifferent to changes of temperature, and many thrive equally well in cold and in hot countries. The small brown slug (*Agriolimax laevis*), the Painted Lady butterfly (*Vanessa cardui*), and the barn owl (*Strix flammea*) are familiar examples.

II. To the animals of the second division belong those of which we have distinct evidence, from their geographical range, that they are of Arctic origin. As I hope to prove later on, they have arrived in Ireland directly from the north. Among the Mammals, the reindeer, which formerly inhabited this country, the Irish stoat, and the Irish hare form part of this northern section. The beetles *Pelophila borealis* and *Blethisa multipunctata*, the butterfly *Coenonympha typhon*, the small shell *Vertigo alpestris*, as well as the common stickleback (*Gasterosteus aculeatus*) have all reached Ireland from the north.[1]

III. The third division includes the bulk of the Irish fauna. In the first place, we have to consider those animals whose birth-place appears to be in South-western Europe, then we have those which originated in the South or South-central Europe, whilst there are others which came to Ireland from the south-west, though they may primarily have migrated there from central Asia across Southern Europe. No very strict line can be drawn between the animals of South-central and those of South-western European origin, but we may with Edward Forbes (33 *a*, p. 12), regard the most southern as the oldest. A good many of these are altogether absent from England, whilst they are mostly confined to the west coast in Ireland. Taking all the Irish southern types into account, we find that the majority are confined, in the remainder of the British Isles, to the south-western parts of England and Wales. In some cases they appear again in the extreme north of England and in Scotland without, however, being known in the intermediate tracts.

We can sub-divide this southern fauna, therefore, into a south-western and a south-central one: to the former belong the well-known bullfinch (*Pyrrhula europaea*), the dipper (*Cinclus aquaticus*),

[1] Among the Irish plants we have some species, such as *Spiranthes Romanzoviana*, *Eriocaulon septangulare* and *Sisyrhynchium angustifolium*, which appear to belong to the same division.

and the natterjack toad (*Bufo calamita*); also the following Mollusca, *Geomalacus maculosus*, *Pupa anglica*, *Helix fusca* and *H. pisana*;—the beetles, *Rhopalomesites Tardyi*, *Eurynebria complanata*, and *Otiorrhynchus auropunctatus*. Among the Irish woodlice, *Platyarthrus Hoffmanseggii* belongs to this first division, as well as the Hemipteron *Lygus atomarius*, and the millipede, *Polydesmus gallicus*. Some of the species peculiar to Ireland have their nearest relatives confined to the south-west of Europe, e.g. *Tegenaria hibernica*, which is closely related to the Pyrenean *Tegenaria larva*.[1]

The badger (*Meles taxus*), is for our purposes a South European type of the second sub-division, though it originated probably in Asia. The following Mollusca also belong here :—*Helix aculeata*, *H. rufescens*, *H. virgata*, *H. acuta*, *H. nemoralis* and many others; also the beetle. *Strangalia aurulenta*.[2]

Fauna of Great Britain and Ireland.

In treating of the fauna of Great Britain and Ireland, I have found the need of a suitable term in contrasting the faunas of the two islands, as "British" is understood zoologically to include the fauna as a whole. At Dr. Sclater's suggestion, I adopt the term *Anglo-Scotian* for the fauna of Great Britain, and *Hibernian* for that of Ireland. When we compare the Anglo-Scotian with the Hibernian fauna, we find that in the former we also have the general, the northern, and the southern constituents just as in the latter; the fauna being, however, richer, we have more of the northern forms (confined chiefly to the north of Scotland), and more of the southern, principally seen in the south of England. But we have in addition an eastern division, composed mainly of immigrants from Siberia and Eastern Europe, which is apparently quite wanting in Ireland (see map 1). Some of the more quickly-spreading Siberians have overrun the whole of Great Britain, but the majority of them are confined to the south-eastern parts of England, and their range scarcely extends to Scotland or Wales. Botanically, this division corresponds to some extent with Watson's (91) "Germanic type of plants."

The Zoogeographical provinces of the British Islands.

Not very many attempts have been made, to my knowledge, to sub-divide the British Islands into zoological or botanical provinces of

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[1] The following Irish plants may be mentioned :—*Arbutus unedo*, *Euphorbia hiberna*, *Simethis bicolor* and *Sibthorpia europaea*.

[2] *Cotyledon umbilicus*, and other plants probably belong to this type.

the great Palaearctic, or, as I should prefer to call it, the Holarctic Region (76 *c*). Only one or two of those who deal with the subject, treat it at all exhaustively. I believe Mr. H. C. Watson was the first to group together the British flora into six provinces, and this idea was

1.—Map of the British Islands indicating roughly the tracts principally occupied by—

— the northern fauna;
╲ the southern fauna; and,
╱ the eastern fauna.

afterwards more completely carried out in his "Cybele Britannica" (91). Messrs. Moore and More adopted similar divisions in their "Cybele Hibernica" (58). Only five botanical provinces were recognized by the late Prof. E. Forbes (33 *a*), who added in each case examples of animals, which seemed to him to belong to these provinces.

On a previous occasion, however, he had separated the British Isles into ten districts, according to the distribution of their Molluscan fauna (33 *c*). In an endeavour to reduce the number of these districts I erred in the opposite direction, in recognising only two, viz. one, including the south-west of England and Wales with the whole of Ireland and Scotland, and the other, the larger part of England and Wales (76 *d*). It was only subsequently that I learned that a distinguished French conchologist, Dr. Fischer (31), had also divided the British Islands into two provinces, from a study of their Molluscan fauna. But his provinces are somewhat different from mine—the south-west of England, Wales, and the west of Ireland form one; the remainder of England, Scotland, and the rest of Ireland the other (31, pp. 51–84). An important point, relating to the subject I am about to discuss, is that Dr. Fischer's first province represents in his scheme only part of a larger "Atlantic province" of the European sub-region, while the second, which includes the greater part of England and Ireland, and the whole of Scotland, is a portion of his "Germanic province."

Another division of the British Islands into two districts has been proposed by Mr. Jordan (44, pp. 45–52). Both are portions of his large Germanic sub-region of the Holarctic region. One of them includes Scotland and the north of Ireland, the other the remainder of Ireland, England, and Wales. The latter province forms only part of a larger "Celtic district" to which belong also Holland, Belgium, North, Central, and South-west France.

In describing the collections illustrating the geographical distribution of animals in the Dublin Natural History Museum, Mr. Carpenter referred to the fact that he had, in one of the cases, roughly grouped the animals of the British fauna in three divisions, *i.e.*, those with a wide range over the British Islands, those characteristic of the south-eastern and lowland districts of Great Britain (which he calls the "Teutonic Fauna"), and those characteristic of Ireland, and of the western and highland parts of Great Britain. The animals of the latter division he has termed the "Celtic Fauna" (16 *a*, p. 117). He recognized more recently that it contained two distinct groups of animals, one including those of northern and the other those of southern origin (16 *b*, p. 215). Lastly, Dr. Kobelt, in a short paper on the Distribution of the British Mollusca, expresses the opinion that the British fauna takes its origin from various sources, and that there are probably more than three distinct groups (52, p. 83).

The significance of these facts has been greatly minimized by the

advocates of accidental introduction—a subject of much importance, of which I have now to treat.

Accidental Means of Dispersal.

This includes, of course, also introductions by man, and, following Darwin, it should more properly be called "occasional means of distribution." Darwin (21 *a*) has shown that seeds of plants may be easily transported to islands by wind, or by floating logs of wood, or even by birds. He has also referred to the fact that locusts and other insects, and eggs of fish and snails are sometimes blown to great distances from the land. He has given many other instances of the manner in which animals and plants might have reached islands. Mr. Wallace, and other naturalists, have likewise collected examples of these occasional introductions. Moreover, all that is known of the means of dispersal of land and freshwater Mollusca has recently been brought together by Mr. Kew (50) in a painstaking and excellent work. It is astonishing how many cases of accidental introductions are known to this author, but nevertheless he remarks (p. 97): "It must be admitted that neither freshwater nor land shells are really well furnished with means of dispersal; the transportal of a species of either group over a large expanse of ocean, or to great distances on land, with subsequent establishment, must be an extremely rare and exceptional occurrence, and one which happens only once or twice in many hundreds of years."

All these views, however, do not particularly refer to the fauna or flora of Ireland, and the only hint that at least a portion of the flora owed its existence in that country to an accidental introduction, was given by Prof. Hennessy (39). He suggested that, as there were times of prolonged and intimate intercourse between the people of the northern coast of Spain and those of Ireland, the conditions for bringing the seeds of various plants from one country to the other probably existed, and that to this fact is due the similarity in the flora of the two countries.

I have already admitted (p. 429) that some of the Irish Mammals may have reached Ireland by means of an accidental introduction through the agency of man. That many of the non-resident birds, and even, perhaps, some residents, are brought to this country by an occasional means of dispersal is undoubted. The same we may assume to be the case with a few shells, worms, wood-lice, spiders, and centipedes, and to a greater extent, perhaps, with insects. But

in the great majority of cases, it is easy to distinguish between a true native and one which has only strayed to Ireland accidentally, and the latter only form an extremely small and insignificant percentage of the Irish fauna and flora. Mr. Murray (60, p. 16) was of opinion that only a slight intermixture occurs in the flora of an island from occasional dispersal, and he was disposed to reckon the proportion of such colonization at not more than two per cent. in the most favourable circumstances. In the fauna he thought it must be much less.

As regards Ireland, I believe the animals derived from accidental or occasional means of dispersal amouut to five per cent. of the whole fauna at the most. Land and freshwater Mollusca are generally looked upon as particularly liable to accidental dispersal.

If they had been to any great extent carried to Ireland by occasional means of dispersal instead of gradually spreading to that country on a former continuous land-surface, speculations based on their range would be futile. Dr. Blandford (8, p. 43), who speaks with an authoritative voice on the subject of distribution of mollusca, says: "The prevalent idea that land-mollusca, or their eggs, are transported by floating logs, appears to me extremely improbable in a great number of forms, because, so far as is known, very few hibernate in wood, or lay their eggs there; and as the wood is carried to the sea during floods caused by heavy rains, which would certainly make every snail leave its hiding place, the notion that some would remain ensconced in the clefts appears to me quite opposed to the habits of the animal."

Darwin (21 *a*, p. 353) tells us how Baron Aucapitaine immersed a number of *Cyclostoma elegans* for a fortnight in the sea, by way of experiment, and that almost all survived the treatment. He naturally concluded that the operculum, with which these shells are furnished was of distinct advantage in enabling them to float across arms of the sea to an island. Supposing Ireland had been stocked in this manner with shells, we should expect operculate species, or even such which provide themselves with a membranous diaphragm during winter, to be abundant. But this is not the case. Neither *Cyclostoma elegans* nor *Helix pomatia*, the two species which were experimented on, inhabit Ireland, though both occur in England and in France. Moreover, as a matter of fact, the shells of the former species have again and again been washed ashore within recent years on the Irish coast; but though this must have been going on for centuries, yet *Cyclostoma elegans* has not established itself in this country. The only Irish

operculate land-shell (*Acme lineata*) lives permanently underground, and is therefore less liable to accidental transportal than other species.

Owing to the facility with which the rabbit was successfully introduced into Australia, and to the fact that many European weeds flourish far away from their native land after having been accidentally transported, perhaps with ballast, we get quite an exaggerated idea of the facility of artificial introductions of both plants and animals.

It is fully admitted that many animals and plants are easily transported to new countries by accidental means or voluntarily by man, but, in most cases, they have not been able to retain a permanent footing in their newly-adopted home. There are innumerable instances on record of species having been planted on spots where they did not previously exist, and the introducers claim that it is highly interesting to watch their progress. In the great majority of cases we find that, fortunately, these species utterly vanish after a few years.

Sportsmen have for many years tried to permanently establish the English hare, *Lepus europaeus*, in Ireland. Lord Powerscourt tells me that he imported a number of them thirty years ago, and that they at first increased, but that latterly they have decreased considerably. They have never spread during all this time, but remained in close proximity to the house where they were originally turned out. From Southern Sweden we hear of similar experiences. Now it cannot be said that a species which thrives so well in England from north to south, could not stand the Irish climate, or that of Southern Sweden, which is not unlike that of Northern Germany, where this hare is common. It is, therefore, manifest that the difficulty of establishing the English hare permanently in these countries is altogether unconnected with climate or food. I shall refer to this subject more fully later on when dealing with the Irish hare.

Attempts have frequently been made to acclimatise snakes in Ireland, but the experiment has always failed. Even the Natterjack toad (*Bufo calamita*), which is common about Dingle Bay on the west coast of Ireland, has been imported in large numbers to Dublin, with a view to establishing it in such suitable localities as the Phœnix Park. Not a trace, however, remained of it a few years after the introduction.

These few instances will suffice to show that it is by no means so easy as it is generally supposed, to establish an animal in an area which it was previously not known to inhabit, and that really only

a very small percentage of the Irish fauna can be due to an occasional means of dispersal. But it will be well to examine the views on the origin of the Irish fauna of the leading zoologists, botanists, and geologists who have made the geographical distribution of animals and plants their special study.

The Irish Fauna and Flora migrated to Ireland on Land.

Few naturalists were more thoroughly acquainted with the British terrestrial and marine fauna and flora than the late Prof. Edward Forbes. His view (33*a*, p. 65) on the subject is therefore of special importance: "The greater part," he says, "of the terrestrial animals and flowering plants now inhabiting the British Islands are members of specific centres beyond their area, and have migrated to it over continuous land before, during, or after the Glacial Period." Dr. Wallace remarks in "Island Life" (89, p. 338): "When England became continental, these (animals of Central Europe) entered our country; but sufficient time does not seem to have elapsed for the migration to have been completed before subsidence again occurred, cutting off the further influx of purely terrestrial animals, and leaving us without the number of species which our favourable climate and varied surface entitle us to." If we turn to Prof. Boyd Dawkins' works, we find the following sentences bearing upon the point at issue (22*a*, p. ii.): "The wild animals are of equal interest to the geologist, the archæologist, and the historian; for they afford to the first a means of classifying the deposits with which he has to deal, while in archæology and history they bear a direct relation to the members and civilisation of the human dwellers in the same region. They are also valuable to the geographer and physicist, since the occurrence of the same animals in islands as on the adjacent continent implies a continuity of land between them in former times." I have already quoted Prof. Leith Adams in my note on the origin of the Irish fauna, and I would only reiterate the statement, that he agreed with Prof. Dawkins' views on this subject. Speaking of the southern fauna of Ireland, Mr. Carpenter remarks (16*b*, p. 218): "The land-tracts over which these distinctly Pyrenean and Mediterranean animals had travelled to Ireland, were covered by the waters of the sea, while early races of men were still able to ramble into Britain over an isthmus where the waves of the Straits of Dover and the North Sea now roll."

These are some of the opinions expressed by zoologists. As for botanists, Mr. Watson is, perhaps, the highest authority on the

geographical distribution of British plants. His view, as expressed in the "Compendium of the Cybele Britannica" (91, p. 72), is as follows: "As a whole the flora of this country sufficiently accords with the belief of a former land continuity between England and the Continent."

Most geologists maintain in a general way that, in later and post-Tertiary times, the British Islands were connected by land with the Continent; but the opinion is chiefly derived from the fauna, and we do not, therefore, get any fresh evidence from a different source. Few, except Prof. J. Geikie, moreover, express themselves clearly as to their views on the former physical geography of Western Europe during these times. Mr. Jukes-Browne, however, gives a more definite, though somewhat guarded, decision on the subject (46, p. 34): "It is quite possible that England was joined to France by land which united the Tertiary and Cretaceous basin of Hampshire with the northern part of France, its southern border being perhaps a range of high chalk downs, which extended south-eastward from the Isle of Wight, and was continuous with the chalk districts of Normandy. It is conceivable that the Oligo-miocene upheaval had lifted this tract of country to a considerable elevation above the sea, the rise being greatest over the southern, or Isle of Wight, axis, but the whole country sharing in the uplift. If this were so, the tract in question would form an isthmus between the eastern and the south-western seas, and may never have been wholly submerged until late Pleistocene time." Speaking of the English Forest-bed Mr. Clement Reid says (72*a*, p. 186): "The large number of Mammals already known from the Forest-bed seems clearly to point to a connexion with the Continent, and to wide plains over which the animals could roam." Prof. de Lapparent (54, p. 1382) deduces from the similarity of the Pleistocene Mammalia of England, with those of the Continent, the existence of an isthmus connecting these countries, which he thinks cannot have been ruptured until a comparatively recent date. Finally, if everyone were of Prof. J. Geikie's opinion, I would have been spared the writing of this paragraph, for he says (35*b*, p. 505). "No one doubts that the flora and fauna of our islands could only have immigrated by a land-passage." But even if none of these naturalists had expressed their opinions on the former land-connexion between the British Islands and the Continent, anyone who carefully thinks over the subject must come to the same conclusion. It is difficult enough to imagine how, under the present configuration of Ireland, the mammoth, the wolf, and the bear reached the island.

But when we come to the less conspicuous Invertebrates, we are confronted with cases which give us even less chance of escaping from the inevitable assumption of a land-connexion with the Continent. How are we, for instance, to suppose that earth-worms reached Ireland, or Testacella, a slug-like mollusc, which spends its entire existence under ground, or *Platyarthrus Hoffmanseggii*, a blind wood-louse, which also lives below the surface of the soil, in the nests of ants, unless by slow migration on land? Having decided then that the bulk of the Irish fauna migrated to Ireland on land, we have next to consider what was the nature of that land-connexion before we proceed to discuss the views as to the time when the migration took place.

On the Nature of the Land-connexion.

Prof. J. Geikie refers to the now submerged land between Great Britain and Ireland in the following terms (35*a*, p. 248): "If the whole area of the British Islands were elevated so as to convert the adjoining seas into dry land, we should find an elongated lake extending from the Scottish Highlands southwards to the regions between Wales and Wicklow county in Ireland, a length of not less than 240 miles, with a maximum depth of 594 feet." In a beautiful map, reduced from the Admiralty charts, Prof. Geikie gives still more details. The southern shore of the lake was in the latitude of Wicklow. It then stretched almost due north, sending off an arm towards the Firth of Clyde, and another to the Sound of Jura. The extreme north-west shore was situated between the Co. Londonderry in Ireland and Argyleshire in Scotland. A little further to the west lay the watershed which divided the rivers draining into the lake to the east from those flowing directly west towards the Atlantic.

Such an elevation of land, as that described, is supposed by Prof. Geikie to have taken place after the Glacial Period, and Mr. Kinahan's views agree with this in the main points (51 *b*). Prof. E. Forbes believed that some of the Irish plants at present confined to the west coast arrived long before the rest of the fauna and flora. (33 *a*, p. 14). According to his theory there was, at an ancient pre-Glacial Period, a geological union or close approximation of the west of Ireland with the north of Spain. The flora of the intermediate land was a continuation of the flora of the peninsula. The destruction of this land had taken place before the Glacial Period, but a number of the southern species had meanwhile reached Ireland. Only the relics, he thought, of this most ancient of our island floras

are now left, the mass of the less hardy species having been destroyed by the climatal changes of the Glacial Period.

These views cannot possibly be upheld any longer. Ireland may have had a southern extension as far as Spain in early Tertiary times, though, as far as I know, no geological proof can be adduced to

2.—Map of the British Islands during Pre-Glacial Times. The shaded parts represent the sea and lakes, the light parts the land. (Rivers have only been inserted on the west coast).

support such a view. But it is a mistake to suppose that the Lusitanian flora, and, as we know now, it is accompanied by a similar fauna, is peculiar to Ireland. Fragments of it occur, undoubtedly, in the south-west of England, in the Channel Islands, and along the west

coast of France. That flora migrated, therefore, along the ancient sea-border from the south, across the south-west of England, or the land that lay beyond it. (See map, fig. 2.)

Another feature in the physical geography of Ireland, which is worth mentioning, is that there seems to be some reason for supposing, as Mr. Close has pointed out (17, p. 242), that the west coast was formerly higher, relatively to the east, than it is now.

By means of these data we can, therefore, construct the annexed map, showing approximately the geographical conditions of Ireland at the time when the earliest migrants reached the country from the south.

Under such geographical conditions as prevailed in ancient Ireland any animal could have walked, or any plant could have progressed, on *terra firma*, from the north of France to Ireland, across the south of England. True, the large river, which emerged from the southern end of the lake referred to above, might have arrested their progress to some extent, but probably much less than a bog or a series of hills might have done. A river, as a rule, changes its course frequently in the course of time, and large slices of country which formed the left bank may, in this way, be suddenly transformed into the right, with their fauna and flora, without any effort on the part of the animals or plants. They also had the option apparently of traversing England northward, and entering Ireland from Scotland. Prof. Leith Adams (1 *a*) and Mr. Alston (3) believed that all the Irish Mammals, and Prof. Geikie thinks that many of the smaller ones, may have adopted this more circuitous route. The range, however, in Ireland of the southern fauna points emphatically to its having entered that country from the south, and not from the north. A very large number of the southern animals are altogether absent from Scotland, and become scarcer as we proceed north in Ireland.

The northern animals and plants undoubtedly came across from Scotland, and in the county of Londonderry, which part of modern Ireland they first touched, they still are more common than in any other portion of the country. But they did not originate in Scotland. Under the present geographical aspect of Great Britain they could only have come from the south. The majority of the northern animals and plants not being known, however, south of Northern England, throws doubt upon such a view. We might suppose that they arrived in the south, when the climate was colder, and that they were exterminated in the present more unsuitable climate of Southern England, while they survived in Scotland. The

difference of climate is much too slight, however, between these two countries to produce such an absolute extinction of the northern fauna and flora in the south of England, and we are forced to the conclusion that they arrived from the north. Especially as a geologist of such eminence as Prof. Judd tells us that (45, p. 1008): "Down to post-Glacial times, Scotland and what are now its out-lying islands, remained united with Scandinavia. But at a very recent period, and indeed since the appearance of man in this part of our globe, the separation of the two areas, so long united, was brought about."

It was from Scandinavia, therefore, that our northern animals and plants came. Many of them possibly originated there, but the home of others lies no doubt far beyond even the confines of Scandinavia, in the Arctic Regions.

Thus Ireland had, as we have seen, two land-connexions with the continent of Europe—one by way of the south of England to France, and the other by way of Scotland to Scandinavia.

Prof. Leith Adams believed (1 *b*, p. 100) as stated above, and in this view he is supported by Mr. Alston (3, p. 6), that Scotland was connected with Ireland long after the latter became disconnected from England, and that the whole of the Irish Mammalian fauna migrated to Ireland by way of Scotland.

On the Time of the Migration.

Before discussing the views current among zoologists and botanists as to the geological period during which the Irish fauna and flora migrated to Ireland, I should like again to draw attention to the fact that the Forest-bed is now more generally recognized as constituting the most recent formation in the Pliocene Series, which is succeeded by the Pleistocene. As the Glacial Period is supposed to have formed a phase of the Pleistocene Epoch, the term "pre-Glacial" throughout this memoir, will apply to the pre-Pleistocene times, and will include the Forest-bed. It must be remembered that I adopt these terms for convenience sake only, and in order to make my views more clear, and not because I agree with them. I shall endeavour to show later on that it is not at all justifiable to place the Forest-bed in the Pliocene Series.

The questions which I have dealt with in the preceding pages have been comparatively simple and easily answerable, but the problem as to the particular geological Epoch or Period during which the fauna arrived in Ireland is an extremely difficult one. With the exception of Prof. Forbes, no one has really attempted to seriously set himself to

unravel the problem, and I need therefore only briefly state the views current among the leading naturalists, who have given some thoughts to it.

Prof. Forbes (33 *a*, p. 14) believed, as already mentioned, that the south-western Lusitanian flora is not only the oldest, but that much of it survived the supposed severity of Pleistocene climate in Ireland. Next in age, comes the northern or Arctic flora, which he held to be glacial (p. 11), and finally the great mass of the fauna and flora migrated to Ireland, in post-Glacial times (p. 10). The deficiencies in the Irish fauna of certain Mammals and Reptiles met with in Great Britain, he explained by the assumption that the migration of the species less speedy of diffusion was arrested by the breaking up of that land-passage which united the two islands. The latter explanation has been adopted by almost every naturalist since.

Prof. Leith Adams treats of the Mammalia only, but I presume his observations apply to the whole fauna. He thinks (1 *b*, p. 86) they migrated from Scotland into Ireland during post-Glacial times. "The absence of the slow-travelling mole and other local species," he says, "together with the amphibian and reptilian evidence furnished by Thompson, seem to me to still further strengthen the belief that the land-communication between Great Britain and Ireland, at the close of the Glacial Period was neither extensive nor probably of long duration."

Dr. Wallace (89, p. 338), differs from the preceding naturalists in so far as he recognizes that *we* possessed before the Glacial Period "a fauna and flora almost or quite identical with that of the adjacent parts of the Continent and equally rich in species." The submergence he says, destroyed this fauna or at least the greater part of it, and the post-Glacial elevation and union with the Continent cannot have been of very long duration. "The depth of the Irish Sea being somewhat greater than that of the German Ocean, the connecting-land would there probably be of small extent and of less duration, thus offering an additional barrier to migration; whence has arisen the comparative zoological poverty of Ireland." Dr. Wallace does not specify whether his "*we possessed*" includes Ireland, but it is evident that he believes the mass of the Irish fauna and flora to be of post-Glacial origin.

We obtain something more definite from Prof. Boyd Dawkins (22 *b*, p. 152), for he tells us that it is highly probable that the bear, wolf, fox, horse, stag, Alpine hare, and also the mammoth and reindeer, have lived in Ireland before the Glacial Period. Whether these became extinct during the Glacial Period and remigrated to Ireland

afterwards he does not mention. During later Pleistocene times, he continues, Southern and Eastern Britain were inhabited by an abundant Mammalian fauna, while ice and sea acted as barriers to their free migration into Ireland and Scotland. This is a very important point and one with which I thoroughly agree, viz. that a barrier prevented the fauna during later Pleistocene times from invading Ireland and Scotland. As Prof. Dawkins looked upon the Pliocene Forest Bed as early Pleistocene, it is a mere change of phraseology to speak of the barrier as having existed throughout what we now call Pleistocene times. At the close of the Glacial Period the British Islands stood, according to Prof. Dawkins (p. 151), at least 600 feet above their present level, and were joined to the mainland. I cannot quite agree with him here. The whole west coast of the British Islands must have been at a higher level than it is at present throughout the Pleistocene Epoch and joined to Norway, not separated as he indicates on the map. No doubt there is a deep hollow running along the south-east coast of that country, but it becomes shallower as we go north towards the Atlantic. The hollow, however, is probably of recent origin, as has, I think, been suggested by Prof. J. Geikie.

That the bulk of our recent fauna migrated to Ireland at this time is evidently Prof. Dawkins' belief, though I cannot find that he expresses a definite opinion on the subject. Prof. J. Geikie solves the problem of pre-Glacial or post-Glacial migration without much trouble, for he remarks (35 *a*, p. 505): "As neither our animals nor our plants could have existed here" (in the British Islands) "during the last Glacial Epoch; it follows that they must be of post-Glacial age." Similarly, Mr. Kinahan informs us (51 *b*, p. 6) that the great northern ice-cap, which was moving south over Ireland, crushed all before it.

The evidence as to the existence, however, of a fauna in Southern England at any rate, during the Glacial Period, is so overwhelming that I can hardly believe that many naturalists will accept Prof. Geikie's views. Nevertheless, there are certainly some who do, and among them Mr. Clement Reid, the distinguished author of the "British Pliocene Deposits," who remarks (72 *b*, p. 300) that, "in the Britain of the present day, we may study the re-peopling of a country over which everything had been exterminated."

Though Mr. Carpenter (16*b*) admits that what he has termed the "Celtic fauna" of Ireland is much older than the Teutonic, he seems disposed towards the view that the migration took place "in Pleistocene times, as the ice passed away." He concurs therefore

with most of preceding writers in the view that the migration was post-Glacial.[1]

Mr. Lydekker (57 *b*) does not wish to offer a definite opinion on the subject, though he prefers to incline towards Dr. Wallace's view. Mr. Barrett-Hamilton (4, p. 68) thinks that there is much in favour of the view I expressed in my short preliminary note (76 *a*), but that an adaptation of Mr. Bulman's views to Ireland might account for the peculiarities of the flora and fauna of the south and west. This brings us to Mr. Bulman (14 *a*). He dissents from the conception that the British fauna and flora was totally destroyed during the Glacial Period, and is satisfied that survivals from pre-Glacial times persist in the British Islands to the present day. As the south of England was free from ice, we had, as he observes, "an area capable of affording an asylum to a considerable number of our plants and animals." I perfectly agree with him, especially in his suggestion that there may have been other areas in the British Islands besides the south of England fitted to preserve temperate life during the Glacial Period.

The opinions expressed by zoologists, botanists, and geologists is overwhelmingly in favour of the post-Glacial age of the present British fauna. It is believed, even by most of those who admit that the British Islands were inhabited by a very similar fauna and flora in pre-Glacial times, that a vast destruction of animal and vegetable life took place during the Pleistocene Epoch, and that very few, if any, species survived the change of climate brought about by the Glacial Period. As I have already indicated, I do not share these views. However, before stating my arguments, not only as to the time of the migration, but as to the changes in the physical geography of Europe on which it depends, I will briefly summarize my conclusions.

Conclusions.

At the commencement of the latter half of the Pliocene Epoch, or we might say about the time of the deposition of the Red Crag, the Atlantic was closed in the north by a continuous land-connexion between northern Scandinavia, Spitsbergen, Franz Joseph's Land, Northern Greenland, and Arctic North America. (See fig. 6, p. 466.) The Pacific was likewise separated from the Arctic Ocean by a land-barrier between Alaska and Kamtchatka. The Arctic fauna and flora was thus enabled to spread into Northern Europe and North America. England was also connected with France and Ireland, and Scandinavia and Ireland with Scotland. (See p. 441).

[1] Mr. Carpenter has changed his opinion since (see "Irish Nat.," 1896, p. 65).

A marine expansion from the White Sea then spread across Northern Russia into the North European plains, and the sea thus formed, which I propose to call the North European Sea, joined the united basins of the Aralo-Caspian and Black Seas. The Siberian fauna was, therefore, unable to enter Europe, while the more southern Central Asiatic fauna continued to migrate into Southern Europe, as in Miocene and early Pliocene times, by a land-connexion which joined Asia Minor and Greece.

A gradual retreat of the North European Sea to the north opened up a passage in Eastern Europe by which the Siberian fauna poured into Central Russia, Germany, France, and England. (See fig. 5, 461.) There is distinct geological evidence that this vast migration of the Siberian fauna and flora occurred after the deposition of the lower continental boulder-clay. The advance guard composed of Mammals arrived in England during the deposition of the Forest-bed. This marks, therefore, not only the time of the first retreat of the North European Glacial Sea, but also that of the disconnexion of England and Ireland, since none of the Siberian Mammals entered the latter.

Meanwhile the Central and South Asiatic Mammals, which, as I mentioned, had rambled into Southern Europe, spread into Northern Africa and Western Europe along the shores of the Mediterranean. Many subsequently invaded Central Europe, and also spread north into Great Britain and Ireland. These and the Arctic Mammals mostly retired before the Siberian invaders. Hence the purely Arctic species had also reached Western and Central Europe before the advent of the latter.

The Siberian Migration.

As my conclusions contain much with which many geologists will probably disagree, I shall commence by making some statements, which are universally acknowledged to be founded on reliable evidence.

There is a general concurrence of opinion among geologists that the climate of Europe in early Tertiary times was almost tropical, and that during the succeeding epochs the temperature became more and more temperate, and at last intensely cold, culminating in the Glacial Period, and that since that time the climate has again ameliorated. To quote Sir Archibald Geikie's words (34, p. 837): "At the beginning the climate was of a tropical and sub-tropical character, even in the centre of Europe and North America. It then gradually became more temperate, but flowering plants and shrubs continued to live even far within the Arctic Circle, where, then, as now, there

must have been six sunless months every year. Growing still cooler, the climate passed eventually into a phase of extreme cold, when snow and ice extended from the Arctic regions into the centre of Europe and North America. Since that time the cold has again diminished until the present thermal distribution has been reached."

The late Prof. E. Forbes pointed out, as I have already mentioned (p. 429), that the Lusitanian element in the flora of the south-west of Ireland is the oldest; and so much was he impressed with that idea, that he held that it must have arrived long before all other British plants. We know now that many of the animals belonging to that same migration, e. g. *Geomalacus maculosus*, offer examples, as well as many of the plants, of what is known as "*discontinuous distribution.*" And this alone is a proof of the great antiquity of that Lusitanian element in the Irish fauna and flora. "Discontinuity," says Dr. Wallace (89, p. 69), "will therefore be an indication of antiquity; and the more widely the fragments are scattered, the more ancient we may usually presume the parent to be." Now, the original home of that fauna and flora is South-western Europe, possibly even some area still further south, of which some of the Atlantic Islands may be the last remnants. The homes of all other components of the British fauna and flora lie further north. The bulk of the Irish fauna and flora, though southern, is derived, as I stated (p. 429), from South-central or Central Europe. Their distribution is continuous across England, and they are distinctly of more recent origin than the Lusitanian element.

We then pass on to the northern or Arctic division of the Irish fauna and flora which came last, and which has scarcely penetrated the island. Hence, there is no doubt that the sequence in the origin of the fauna and flora of Ireland from the temperate to the Arctic agrees perfectly with what we have just learned was the succession of the climates during the more recent geological epochs. When the climate was mild in Ireland the southern animals and plants migrated north; as it gradually became colder they ceased coming north, and species accustomed to more temperate climes took their place, until at last the Arctic ones began to arrive.

In speaking of the Irish Arctic fauna, we must not, as so many naturalists have done, confuse animals of an Arctic with those of a Siberian origin. It is very important to distinguish these two elements, both of which are present in the fauna of Great Britain, though only the former has reached Ireland.

It is now a good many years ago since Mr. Bogdanov (9, p. 26) has brought under our notice that the Arctic animals which have

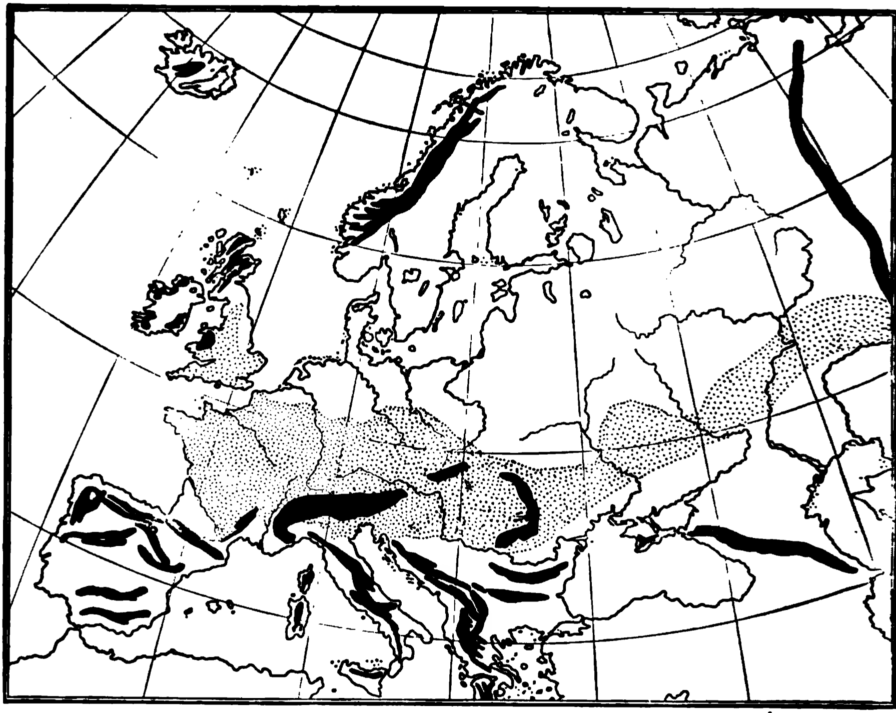
been discovered in the Pyrenees, viz. the reindeer, the Arctic hare, the willow grouse, &c., have nothing to do with the animals which invaded Europe from Siberia during the Glacial Period. In that they are, indeed, of quite a distinct origin, and that they came from Scandinavia, I fully agree with him, but will leave the discussion of the Arctic migration until I have considered the origin and history of the Siberian fauna.

In order to show the importance of the Siberian element in the English fauna, I will give a list of the species of the Mammals which have migrated to Great Britain from Siberia, marking those with a * which still exist or only became extinct in historic times in the country. There is no reason to suppose that any of the latter became extinct and have since been re-introduced.

Canis lagopus.	Myodes leminus.
Gulo luscus.	,, torquatus.
*Mustela erminea.	*Mus minutus.
* ,, putorius.	*Arvicola agrestis.
* ,, vulgaris.	* ,, amphibius.
*Sorex vulgaris.	,, arvalis.
Myogale moschata.	* ,, glareolus.
Lepus diluvianus.	,, gregalis.
* ,, europaeus.	,, ratticeps.
Lagomys pusillus.	Equus caballus.
*Castor fiber.	Antilope saiga.
Cricetus songarus.	Ovibos moschatus.
Sphermophilus eversmanni.	Alces latifrons.
,, erythrogenoides.	,, machlis.
	Rangifer tarandus.

We have geological evidence that most of these twenty-nine species of Mammals emigrated from Siberia to Europe across the Steppes of Southern Russia. Along with them came a large number of other forms of life, and also plants; and as we advance eastward from England, we meet with them in increasing numbers to the present day. But not only on the Continent do we find these survivals of the vast Siberian migration which has been so ably described by Prof. Nehring (62*a* & *b*), no less than ten species still live in Great Britain (including the recently extinct beaver). On the other hand, not more than three of the species mentioned on the list above have been found fossil in Ireland, and only one still survives. This very significant fact will be referred to more fully later on. Meanwhile

it should be remembered that these three species, viz. *Mustela erminea*, *Equus caballus*, and *Rangifer tarandus*, occur in Ireland in varieties distinct from those found in Central Europe ; and on this and other grounds, to be more fully discussed in another chapter, I believe that they came by a different route from those found in England, and that Ireland was not connected with England at the time of the arrival of the Siberian emigrants in the latter country.



3.—Map of Europe on which the stream of the Siberian migration, as revealed from fossil evidence, is roughly indicated by dots. The principal mountain ranges have been marked in black.

It may be asked, how do we know that these animals migrated from Siberia, and what route they came by? In the first place a large number of them still inhabit Siberia or Southern Russia, and many closely related species which have never reached Europe are confined to Asia. Take, for instance, the genus Arvicola. Over

forty species live in the Holarctic region, while only a few enter the boundaries of the adjoining regions. The majority of them are entirely confined to North America and Asia, while none have a very wide range in Europe. But we have also undoubted geological evidence from the remains discovered in the Tchernosjem district of Southern Russia, and described by Prof. Nehring (62*a*), that a migration on a vast scale must have taken place. And as we proceed westward, we still find in strata of a similar age traces of the same invasion, but in such diminishing numbers of both species and individuals, that there can be no doubt whatsoever as to its direction from east to west. Even at the present day there are occasional recurrences of these events of past ages, though on a much smaller scale. It is not many years ago that an announcement was made to the naturalists of Western Europe that enormous flocks of Pallas's sand-grouse (*Syrrhaptes paradoxus*), a native of Central Asia, had suddenly appeared in Eastern Germany. A few weeks later they invaded England, and a good many even came as far as Ireland.

The accompanying map has been constructed from data furnished by fossil remains of the Siberian fauna,[1] and is intended to show more clearly the direction of the migration throughout Europe in past times. More recently many of the survivors of this migration in Europe have spread into regions to which they had originally no access. Thus many have penetrated into Scotland, Scandinavia, Italy, and the Spanish peninsula long after the bulk of the invasion had either become extinct or had retired to their native home.

According to the prevalent views of the origin of the Alpine fauna,[2] the more Arctic members of the Siberian invasion should have found a congenial home in the Alps, but they did not survive there any more than in the plains. Such typical Arctic species as we find there, for example the Arctic hare, either originated in the Alps, or migrated to them at a much earlier period (see p. 471).

We have still to inquire into the causes which led to the Siberian migration, and to ascertain the geological period during which it took place. In order to arrive at a more satisfactory conclusion on these problems, it is of some moment to study the extinct fauna of Siberia.

"The Siberian palæontologist," observes Tcherski (88, p. 487),

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[1] The distribution of fossil Mammalia has been compiled from Nehring (62 *b*), Woldrich (93), Woodward and Sherborn (95), Harlé (38).

[2] Compare these views with those expressed on this subject by Prof. Th. Studer (82, p. 28).

"is confronted with enigmas of the very contrary nature to those which the learned men of Europe have striven to unravel. He vainly attempts the solution of the problem of how to account for the remains of a southern fauna in the ice-bound northern latitudes of his own country, whilst the latter marvel at the past range of Arctic animals to Southern Europe."

The brilliant researches of this distinguished Russian naturalist have been collected together in a memoir on the scientific results of an expedition to the New Siberian islands (88). We learn from this interesting work that remains of the Saiga antelope, tiger, European bison, mammoth and rhinoceros have been discovered not only in the extreme northern limits of the mainland of Siberia, but even in the New Siberian Islands, which are situated in the same latitude as the northern part of Novaya Zemlya. "It is evident," says Tcherski (p. 451), "that these large animals could only have lived in these extremely northern latitudes under correspondingly favourable conditions of the vegetation, viz. during the existence of forests, meadows and steppes."

It is generally assumed, he continues, that the European fauna which was driven south during the Glacial Period, regained gradually their former territory in post-Glacial times.

If we applied the same principle to Siberia, and if it is assumed that the remains discovered on the New Siberian Islands are of post-Glacial origin, we must also inquire into the causes which produced such remarkable changes of climate in Northern Asia within recent times. Or we might, resumes Tcherski, suppose that this migration from the south to the Arctic regions of Siberia, took place in the so-called Interglacial Period. But if such an abnormal amelioration of climate had happened within the Arctic Circle in Northern Asia, it is evident that similar or even more intense effects, must have been produced in Europe, which entirely disagrees with the palæontological data. Moreover, interglacial deposits are wanting almost all over European Russia, and as there are no indications (p. 462) that Siberia was glaciated during the earlier portion of the Glacial Period, it seems all the more unwarranted to conceive such climatic fluctuations.

Tcherski believes (p. 468) that there is no doubt that the gradual lowering of the temperature, which has been clearly demonstrated to have occurred in Europe and North America during later Tertiary times must also have affected Siberia, and as some Siberian forms of life had already made their appearance in Western Europe in pre-Glacial times (Forest-bed), a considerable southward extension of the

Siberian fauna must have taken place during the post-Tertiary (Pleistocene) Epoch. "We have evidence," he says (p. 472), "that at the beginning of that epoch, the Arctic Sea extended further south than it does now in North-western Siberia, and that throughout the country the climate was moister, though this only led to isolated and unimportant glaciation in the mountainous regions."

After a careful study of the geological data collected on the mainland and the New Siberian Islands, Tcherski finally concludes (p. 474) that the southward retreat of the North-Asiatic fauna was continued, though very slowly, throughout the Pleistocene Epoch without breaks or fluctuations, even during the time of the most important glacial developments in Europe. At last the frosts gradually penetrated the soil, and the former haunts of the large Ungulates were then probably only visited during the summer migrations. In exceptional cases the carcases of mammoths, musk oxen, and other animals were preserved in the frozen soil of these northern latitudes to the present day, and there, what are now Arctic species, had undoubtedly lived together with those of southern origin.

Very similar views were held by Brandt, who was probably the highest authority on the Siberian fauna. He was of opinion (12, p. 249) that the northern half of Asia was inhabited already in Tertiary times by the present fauna, with the addition of several species now extinct, and that Europe and Asia subsequently underwent a change of climate. In consequence of the increasing cold the vegetation of Northern Asia suffered severely, and both plants and animals migrated during the Glacial Period towards the south and west, where they found more genial conditions.

Against these views of Tcherski and Brandt, it might be urged that, as certainly the bone beds in the Liakov Islands (New Siberian Islands) rest upon a solid layer of ice of nearly seventy feet thick, the Mammals must have migrated north after the amelioration of the Arctic climate which prevailed there during the formation of this ice. As a rule, however, these layers of ice contain seams of mud and sand, and it has been suggested by Dr. Bunge, who visited the New Siberian Islands recently at the instance of the Imperial Academy of St. Petersburg, that the ice has formed, and is still forming, in fissures of the earth (15). To look upon these so-called glaciers as fossil ice, and as having survived from the Glacial Period to the present day, is a view which, therefore, lacks confirmation.

During the earlier part of the Pleistocene Epoch in Siberia there occurred a marine transgression in North-western Siberia, and to judge

from the numerous lacustrine and fluviatile deposits in the low grounds, the country seems to have been studded with numerous lakes. Prof. J. Geikie informs us (35 *a*, p. 699) that the Hain-Hai or great Dry Sea in Central Asia was, during Glacial times, a much better watered region than it is now. We have also strong evidence that the Caspian, towards the commencement of the Pleistocene Epoch, extended not only considerably further north, but also further to the east, and was indeed joined to the Sea of Aral. The slight extension of local glaciers in the Siberian mountains, during those times, does not, therefore, indicate a cold climate, but is the natural result of the more humid conditions which prevailed in Siberia. Tcherski thinks that there is no evidence to show that the Siberian rivers formerly flowed in a different direction from that at present, as has been supposed by Sir Henry Howorth (40 *b*) to have been the case.

Eastern Siberia seems to have been more elevated than it is at present, for the New Siberian Islands must have been joined to the continent. A considerable area in the Behring Straits was also raised above sea-level, so as to unite Asia and North America. By means of this land-connexion, the red-deer, mammoth, grisly bear, and other large Mammals migrated across to the New World; and, on the other hand, Asia received the woodland caribou, and possibly also the horse, in exchange. An enormous extension of the Siberian fauna evidently occurred in later Pliocene times; but, nevertheless, there is strong evidence for the assumption that no direct emigration to Central Europe took place then. An indirect emigration, which will be referred to more fully later on, did, however, occur to some extent.

A southern variety, *Lepus europæus mediterraneus*, of the common European hare inhabits the Mediterranean region; and since it reached the islands of Corsica and Sardinia and also Northern Africa, which can be clearly demonstrated to have been separated from the mainland of Europe at a comparatively early geological period, it must have migrated from Asia much before its more northern relative. We have a similar case in the bullfinch (*Pyrrhula europæa*), with the difference that it wandered a good deal further than the Mediterranean hare. On its arrival, in the extreme western limit of the Mediterranean, it turned north and invaded even the British Islands, and spread also into Western Germany from France. But a larger form, known as the Russian bullfinch (*Pyrrhula major*), emigrated from Siberia at a later period, and occupied the greater part of Central and Eastern Europe.

I mentioned already, on a previous occasion (76 *c*, p. 436–474),

that this migration passed across a land-connexion which united Asia Minor and Greece, but that the later Siberian one took a very different course, as we shall see presently.

Now, several naturalists, who have studied the problem of the former Siberian emigration of Mammals, have felt that if the physical geography of Eastern Europe in later Pliocene times had been what it is at present, we should have some evidence in that region of a migration from Asia. But in the older strata no Siberian Mammals are to be met with, and it has been suggested that nothing less than a very formidable barrier could have prevented the Siberian fauna from invading the neighbouring continent.

I think the distinguished Russian zoologist, Prof. Brandt, was the first to draw attention to this circumstance. In referring to the former occurrence of mammoths in Northern Siberia, he says (12, p. 86):—"The large extension of forests in the north may have taken place at a time when an arm of the sea stretched from the Aralo-Caspian to the Arctic Ocean, and conducted warm water to it from Central Asia. The gradual disappearance of this connexion may have induced a steady decrease of warmth in Northern Asia, so that ice and frozen soils formed, which lowered the temperature still more. All this may have happened at the time the Glacial Period commenced in Europe. The large Mammals of Northern Asia migrated southward in consequence of the deleterious influence of the cold on the vegetation in the north. From there, they were now able to gradually proceed west, as the arm of the sea, which formerly had prevented extension of range in that direction, had disappeared." Prof. Boyd Dawkins expressed himself in very similar language, a year later (22*c*), as follows:—"Before the lowering of the temperature in Central Europe the sea had already rolled through the low country of Russia, from the Caspian to the White Sea and the Baltic, and formed a barrier to western migration to the Arctic Mammals of Asia."

But the view of Professor Dawkins differs from that of Prof. Brandt, and also from that of Mr. Köppen (53, p. 42), who likewise believed in a connexion between the Caspian and the Arctic Ocean, in one material point, in so far that he places his connexion to the west of the Ural Mountains instead of to the east. Since Tcherski has shown that Western Siberia is largely covered by freshwater deposits, the assumption that the Aralo-Caspian had been in direct communication with the Arctic Ocean, as recently as the Pliocene Epoch, can no longer be maintained; but, as we shall see presently, there is some evidence in favour of a European connexion between the two seas.

Some of those who take for granted that huge glaciers overran Northern and Central Europe in early Pleistocene times will be more inclined perhaps to favour the view that, if there existed any barrier shutting out the Siberian fauna from Europe, this took the form of a glacier. This indeed is the opinion expressed by Bogdanov, who informs us (9, p. 26) that an immense glacier, covering the greater part of the Ural Mountain, prevented the Siberian fauna from entering Europe, while a northern fauna, including the reindeer, spread from Scandinavia, as far south as the Pyrenees.

To judge from the mildness of climate in Siberia, during the Pliocene and even during the greater part of the Pleistocene Epoch, it is extremely unlikely that Bogdanov's theory could be correct. The barrier, if there was one, must have been of a character not at variance with the temperate climate, evidently prevailing in Northern Asia in Pliocene times. As I mentioned before, there is not only evidence in favour of such a barrier, but also that it was of an aqueous nature. As the existence or non-existence of this barrier plays an important rôle in the history of the Siberian migration, it is necessary for me to dwell on this subject for some little time before following the final entry of the fauna on European soil.

Professor Karpinski mentions (47, p. 183) that, during the first half of the post-Tertiary (or Pleistocene) Epoch a large brackish inland sea covered the south-eastern portion of Russia. This not only included the whole of the Caspian and the Sea of Aral, which were connected with one another, but it stretched far to the north of their present boundaries, as far indeed as the mouth of the Kama, in Northern Russia (see map on opposite page). This vast inland sea communicated probably by a system of lakes and channels, with the Northern Ocean. Professor Karpinski's last assumption is based on the occurrence in the Caspian of some Arctic marine forms of life, but he does not consider that their presence warrants the belief in a direct communication between it and the Arctic Ocean. Unfortunately Professor Sars has not quite completed his investigations into the Crustacean fauna of the Caspian, but what has been known for many years of its general facies, has lead many naturalists to conclude that a direct communication between the inland sea and the ocean must have taken place in comparatively recent times. As Professor Sars in the "Crustacea Caspia" (75*b*, p. 401) remarks, "The Mysidae are generally regarded as being of true marine origin, and of this family eight species are now known from the Caspian, half of which also occur in the Black Sea." Of the Order Cumacea, which is exclusively marine, ten species are described in

Professor Sars' work, but none of these or the Mysidae seem to range beyond the Black Sea. It was formerly believed that *Mysis relicta* of the Arctic Ocean, inhabited the Caspian, but this does not appear to be the case; however, the northern marine Isopod, *Idotea entomon* has been shown to exist in it. Moreover, a closely allied form of the Arctic seal, viz. *Phoca caspica*, lives in the Caspian, while the Caspian herring (*Clupea caspica*) is related to the northern herring, and a still more closely allied species, *Clupea pontica*, occurs in the Black Sea.

4.—Map of European Russia (after Karspinski). The faintly dotted parts indicate the former extension of land-ice, the strongly dotted ones represent the Aralo-Caspian and other post-Pliocene basins.

These latter species are certainly of northern origin, but of the Crustacea mentioned by Professor Sars, we can only say that they have certainly descended from marine ancestors. The probability, however, is strongly in favour of their having entered the Caspian area from the north, since it has been proved by Professor Suess (83, vol. i, p. 437) that the Black Sea and Caspian were, until quite recent times, certainly

up to the post-Glacial Period, separated from the Mediterranean. Whether the Caspian was even after that time connected with the Mediterranean indirectly through the Black Sea appears somewhat problematical.

I think we have therefore grounds for the belief, from purely faunistic reasons, that the Aralo-Caspian, which was probably joined to the Black Sea, was actually connected with the Arctic Ocean, or at least that part of it known as the White Sea, during the earlier part of the Pleistocene Epoch. Mr. Jamieson came to a similar conclusion on metereological grounds (41). As heat and dryness were much lessened during the Glacial Period, he thought there must have resulted a much smaller evaporation from such inland seas as the Black Sea and the Caspian. The level would therefore have risen, until their surplus waters were discharged along the east flank of the Ural Mountains into the Arctic Ocean. This view presupposes a cold climate over Central Russia, but as we have seen that the temperature must have been more equable and perhaps even milder than at present, the waters of the inland sea for this reason did not overflow at all. On the contrary, the large Russian inland sea was merely a remnant of a still larger sea reaching west as far as Croatia, during the early Pliocene Epoch. Evaporation in fact exceeded precipitation, just as it does at present in the Mediterranean, with the result that as soon as the junction between the southern and the northern seas was effected, a steady current began to flow from the latter to the former.

We are told by Professor Karpinski (47, p. 182), that at the time when the Aralo-Caspian Sea extended north as far as the Kama River, huge glaciers descended from the Scandinavian Mountains across the Russian plains similar to those now being formed in Greenland. Traces of this southward extension have been met with as far south as the 51st parallel of latitude. Professor Karpinski and the majority of Continental geologists are of opinion that the boulder-clay or "Geschiebe-Mergel," covering not only Northern Russia, but a large part of Germany, represents the ground-moraine of these huge glaciers referred to. If they are contemporaneous, therefore, with the above-mentioned Caspian deposits, it is perfectly clear that the sea in which the latter were laid down could not have communicated with the White Sea, nor does it seem to me possible how a temperate climate could have existed in Siberia, whilst the whole of Northern Europe was shrouded in a mantle of ice. It might be urged that the Caspian deposits are not contemporaneous with the boulder-

clay. Mr. Sjögren (78), however, has shown that hitherto all the observations have pointed to the fact that the former do not overlie the boulder-clay, but occur side by side, a circumstance which certainly speaks for the contemporaneousness of the two formations.

We have to choose consequently between one of two alternatives—either Northern Russia was covered by a mass of ice, and then Siberia must have been practically uninhabitable, or the climate of both Europe and Siberia were more temperate than they are now. In the face of the numerous works which have been written in recent years by Prof. J. Geikie, Prof. Penck, Mr. Falsan, Prof. Bonney, and many other distinguished geologists, on the proofs of a cold and even Arctic climate in Europe during the Glacial Period, it may seem futile to doubt what is put forward as a well-established fact. But with Tcherski I have been led to conclude, that Siberia had a comparatively mild climate in Pleistocene times. Northern Europe could not—that being the case—have been glaciated in the manner above described. Before following the migrations of the Siberian fauna to Europe, I must therefore dwell for a little while on the origin of the Continental boulder-clay.

What is now looked upon as such an established fact, was explained in quite a different manner fifty years ago. Murchison, de Verneuil, and von Keyserling, who studied these identical Russian boulder-clays, which are now regarded as ground moraines of huge glaciers, came to the conclusion that they were laid down by the sea, and as regards the origin of these clays the following is their verdict (59, p. 536):—"If, as we believe, it is impossible to imagine that the detritus in question should have been carried across the Baltic Sea, and from the level of that sea several hundred miles up the streams, under any conceivable terrestrial conditions, it follows from these considerations alone that all theories to account for the movement of such bodies over the dry surface of the earth are inadmissible. The hypothesis of glaciers advancing up-hill for the distance of 700–800 miles involves, in fact, a physical absurdity." The present champion of the theory of the marine origin of the boulder-clay in Germany, Mr. Berendt has, in a lengthy essay, published about sixteen years ago, given his reasons for still adhering to the old views (6).

A good many of the facts brought forward by this writer seem to be equally well explained by either the terrestrial or the marine theory; but Prof. Penck (66*b*) in an article, written in answer to Mr. Berendt, certainly adduces several, which, I believe, have never been satisfactorily elucidated by the marine mode of origin of the

boulder-clay, such as the occurrence of giant kettles, the absence of marine shells over large tracts of country, &c.

According to Prof. J. Geikie (35*a*, p. 432), the boulder-clay which has been traced over a vast area in Northern Europe, exactly resembles in all important particulars the similar accumulations met with in the British Islands. They resemble one another also in the occasional occurrence of sea-shells, the frequent appearance of bedded deposits, and the often inexplicable course taken by boulders from their source of origin. It is well, therefore, to weigh the words recently uttered by Prof. Bonney (10*a*, p. 280) before rushing to the conclusion that this boulder-clay necessarily represents a ground moraine. "The singular mixture," he says, "and apparent crossing of the paths of boulders, as already stated, are less difficult to explain on the hypothesis of distribution by floating ice than on that of transport by land-ice, because, in the former case, though the drift of winds and currents would be generally in one direction, both might be varied at particular seasons. So far as concerns the distribution and thickness of the glacial deposits, there is not much to choose between either hypothesis; but on that of land-ice it is extremely difficult to explain the intercalation of perfectly stratified sands and gravels and of boulder-clay, as well as the not infrequent signs of bedding in the latter." The view of the marine origin of the British boulder-clay has been most carefully worked out by Mr. Mellard Reade (71), whilst Mr. Bulman (14*b*) brought forward some additional objections to the terrestrial hypothesis. Sir Henry Howorth (40*a*) has gathered together a surprising number of facts in favour of the marine theory, and has embodied his wide knowledge of glacial geology in a work which is quite a storehouse of information. With his conclusions, however, I cannot agree. It seems to me that the distribution of the drift can be explained without invoking a great diluvial catastrophe.

I think that I shall be able to advance some additional evidence in favour of the view that the boulder-clay of Europe is a marine deposit, and that Northern Russia and Germany were not covered by glaciers during the Pliocene or Pleistocene Epochs.

It has been urged by many writers, both on zoological and geological grounds, that at some time during the Pleistocene Epoch, or perhaps even later, the White Sea and the Baltic were joined across Northern Russia, and that then also the lowlands of Northern Germany, and those of Sweden and Norway were partially flooded. The zoological evidence alone, that such a junction has taken place, within recent geological times, is very strong indeed.

The Arctic seal (*Phoca annellata*), which, as we have learned, is closely allied to the Caspian seal, is also found in the Gulf of Bothnia, and in Onega and Ladoga lakes, but is quite absent from the remainder of the Baltic and the west coast of Scandinavia. We have a similar case of distribution in the four-horned sting-fish (*Cottus quadricornis*) which inhabits the White Sea and then again the Baltic as far south as Gothland, and also the lakes Wetter and Wener in Sweden, but does not occur on the west coast of Scandinavia. Its principal food consists in the isopod *Idotea entomon*, which also inhabits the Caspian, and is a typical marine form. It occurs in many of the Russian, Finnish, and Swedish lakes, and also in the Baltic, but is absent from the west coast of Scandinavia. Perhaps the best known form, with a similar range, is the schizopod *Mysis relicta*. It is clearly a descendant from the Arctic *Mysis oculata*, of which it was formerly considered a mere variety. The amphipods, *Gammaracanthus relictus* and *Pontoporeia affinis*, are two additional well-known Arctic Crustaceans, whose European range differs but little from those above mentioned. But there are others (see Dr. Norquist's writings (64)).

Rudolph Leuckart first applied the name "Reliktenseen" to such lakes as the north Russian ones and the Swedish, containing marine organisms, and supposed to have been flooded by, or to have been in close connexion with the sea at some former period. Lovén, O. Peschel, and others worked out his views more in detail, and strengthened his position in regard to the Reliktenseen. More recently Dr. Norquist (64) strongly defended these views, and so has Prof. Sars (75*a*, p. 124), who remarks, when referring to *Pontoporeia affinis*, that "it constitutes most probably a remnant of the ancient Arctic fauna, existing off the coasts of Europe and North America during the Glacial Period, a part of which still remains in the more isolated marine basins, as the Baltic; whereas another part, by the subsequent rising of the land, was left behind in some of the lakes, where the present species, under certain circumstances, was enabled to adapt itself to live in purely fresh water."

While recognizing the claims of some of the Swedish lakes to be looked upon as "Reliktenseen," Prof. Credner (19) denies altogether that either the Onega or the Ladoga lakes can be regarded as belonging to that class, or indeed that the Baltic ever had any connexion with the White Sea. Moreover he does not believe that the occurrence of marine organisms in inland lakes can be adduced as a convincing proof of the marine origin of such lakes. His chief contention against the relic theory is the fact that marine molluscs are entirely

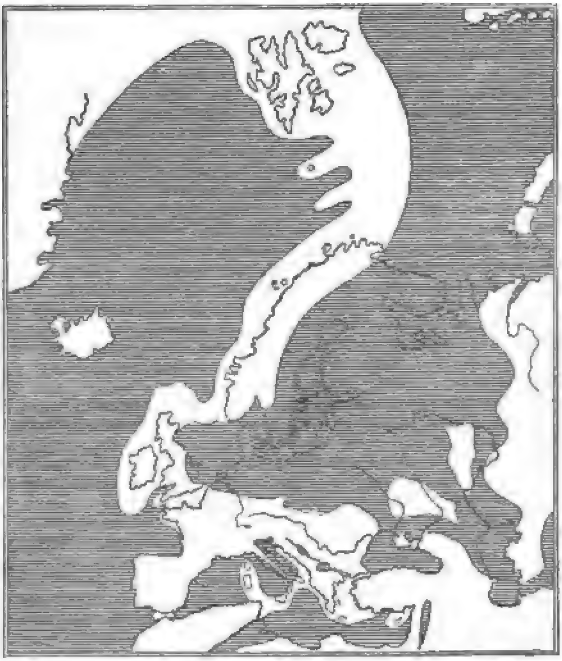
absent from the relic lakes. Had Prof. Credner been acquainted with Prof. Sollas' ingenious explanation of the origin of freshwater faunas (79), no doubt he would have greatly modified his views. Dr. Sollas shows that all freshwater organisms in their early stages of development are provided either with some process enabling them to attach themselves to a foreign object, or that they pass this period within the body of the parent. This is a provision of nature to prevent freshwater organisms from being floated out to the sea, where they would perish, until they have reached maturity, and can cope with floods and currents. But the larvæ of marine mollusca are all free-swimming. They are a prey to the slightest current, and have no chance of settling down in freshwater lakes permanently, unless a radical change were to take place in their mode of development.

To judge from the relic fauna in the North European lakes, we may safely assume that the area occupied by the plains in the extreme north of Russia and in Finland and Sweden was, in recent geological times, occupied by the sea. But we have still to take into consideration the views expressed by geologists on this subject from purely geological evidence.

I have already mentioned, what Murchison, de Verneuil, and von Keyserling's opinions were on this point. In speaking of some Arctic shell-beds, which underlie the boulder-clay on the coast-lands of the Baltic, Prof. J. Geikie (35*a*, p. 442) remarks :—"It would seem, then, that before the deposition of the lower boulder-clay of those regions, the Baltic Sea had open communication with the German Ocean. Some geologists have supposed that the Arctic fauna of the East Prussian clay-beds may have immigrated from the north rather than from the west. But there is no direct evidence that the lands lying between the Baltic and the White Sea were under water during the formation of the shell-bed in question." Prof. J. Geikie, however, admits that at a later period the Baltic and White Sea were joined :— "The dissolution," he says (p. 486), "of the great Baltic glacier was accompanied and followed by the depression of a considerable portion of the Scandinavian peninsula. Communications thus obtained between the North Sea and the Baltic by one or more straits across Central Sweden, and there was likewise wide communication between the Baltic and the White Sea, by way of Lakes Ladoga and Onega."

The assumption that the Arctic mollusca were admitted from the Atlantic to the German Ocean before the deposition of the lower boulder clay, and then found their way into the Baltic, is altogether unwarranted, as I shall show later on. It is extremely probable that

Scotland was connected with Scandinavia till a much more recent period (see p. 441). It is likely, therefore, that a marine transgression from the White Sea took place at the time when the Aralo-Caspian extended much further north than its present boundaries, that the Arctic mollusca migrated from the Arctic Ocean direct to the Baltic, where the pre-Glacial deposits exhibit a curious intermingling of the ancient southern fauna with the newer immigrants from the north.



5.—Map showing land-connexion between Europe and Greenland in later Pliocene times (marked white).[1] The shaded parts were covered by the sea at that time.

Deposits containing Arctic marine mollusca were also discovered below the boulder-clay near the shores of the White Sea, another proof of the former extension of the Arctic Ocean in this direction.

I can only allude at present to an important feature in the physical geography of Northern Europe, which will be dealt with more fully

[1] During deposition of lower continental boulder-clay, or, we might say, in pre-Forest-bed times.

(p. 473), viz., the former continuation of the Scandinavian coast-line in a north-westerly direction to Spitsbergen and North Greenland (see map, p. 461). The cold waters of the Arctic Ocean did not communicate at all with the Atlantic at the time when the above-mentioned changes occurred in Northern Europe, but they poured into the Baltic and the German Ocean, which was then a closed bay, and brought with them the characteristic fauna of the Arctic regions.

The Aralo-Caspian communicated with this large northern sea, which had formed on the North European lowlands, and which we may call the "North European Ocean," at a time immediately preceding the deposition of the upper boulder-clay. But the barrier which prevented the Siberian fauna from entering Europe was the strait or straits which connected the two seas. We can, therefore, accurately fix the period of the beginning of the migration, for it must have occurred as soon as this barrier disappeared; or, if we are able to ascertain stratigraphically the first appearance of the Siberian immigrants in Central Europe, the disappearance of the barrier must have immediately preceded that period.

Thanks to the researches of Prof. Nehring (62*b*), who gives us a vivid picture of Siberian life in Europe as reconstructed from his discoveries of vast stores of fossil remains in Northern Germany, we now know that the migration from Asia took place undoubtedly after the deposition of the lower boulder-clay, or, as we might say, after the first Glacial Period. Prof. Nehring (62*b*, p. 223) seems inclined to think that the migration occurred *immediately* after the deposition of the lower boulder-clay, that is to say, during the Interglacial phase of the Glacial Period. Prof. Penck agrees with him in so far as that he regards the "Loess" in which these remains are found as belonging to the Interglacial Age (66*c*, p. 15). However, we also know that in England remains of Siberian Mammals occur from the Forest-bed upward, whilst none are found in older strata. It seems safe to conclude, therefore, that the Siberian migration took place after the deposition of the lower continental boulder-clay, and during or just previous to the formation of the Forest-bed. But the latter has been lately recognized as a pre-Glacial formation, and it certainly underlies the English boulder-clay. How can we then reconcile these two apparently so very contradictory conclusions—that a migration which undoubtedly set out from the East arrived in Western Europe before it reached Central Europe?

I have shown in a previous Paper (76*c*, p. 448) that such was certainly the case with some Southern Asiatic Mammals, which entered

Europe from Greece, and migrated along the Mediterranean coast to Northern Africa at a time when a land-bridge still existed between it and Southern Italy, and then recrossed again to Spain, where at last they turned north to appear in Western Europe, without having crossed the central parts of the continent. Such, however, could not possibly have been the course of migration of the Siberian Mammals, since they are not found in Southern Europe or in North Africa. Hence one of the two alternatives must be accepted, either some radical mistake has been made in the previous arguments, or the Forest-bed is an Interglacial deposit, and contemporaneous with the "Loess" formation in which the Siberian animals have been discovered in Northern Germany. I believe in the latter hypothesis. If this view should be correct, the whole of the British Pliocene strata or a portion of them, must be of the same age as the lower continental boulder-clay. The marine fauna which made its way west from the Arctic Ocean across the North Russian plains, and reappeared again on the Baltic coasts just before the deposition of the boulder-clay, must have entered the German Ocean and left its traces behind in the strata which formed on the east coast of England. And this is precisely what occurred. "In the oldest member of the Pliocene system," remarks Prof. J. Geikie (35*a*, p. 329), "in the Coralline Crag, the general facies of the fauna clearly indicates a warm, temperate climate, for all the living species are southern forms. In the Reg Crag, however, northern forms begin to appear, and increase in numbers as we pass upwards to the higher members, while at the same time the extinct and southern forms gradually die out." If the view that the Forest-bed represents an Interglacial deposit is correct, as indeed has already been suggested by Professor Geikie (35*a*, p. 479), the whole of the newer British Pliocene is synchronous with the lower continental boulder-clay. I will not dwell on this subject any longer, as it will be more fully dealt with later on, but in the succeeding pages a good many facts in support of this theory will be brought forward.

Let us once more return to Eastern Europe. It will be objected to that, though there may be evidence of a marine trangression from the Arctic Ocean before the lower boulder-clay was laid down, there are such cogent reasons for believing in the terrestrial origin of the latter, that the marine connexion between the Aralo-Caspian and the White Sea which formed a barrier to the passage of the Siberian fauna could no longer have existed. Foremost among the objections to the theory of the marine origin of this boulder-clay is the absence of

marine shells in this deposit throughout almost the whole of Russia, and the fact that the boulders from Scandinavia evidently travelled steadily in a south-easterly direction for a considerable time.

The peculiar conditions of the physical geography of Northern Europe, viz. the complete isolation of the cold Arctic from the warm Atlantic waters, must have produced an excessive precipitation on the Scandinavian mountains in the form of snow (see map, p. 461). Glaciers were formed abundantly on these mountains, as the snowfall during the winter months must have exceeded the amount of snow dissolved during summer. On the west coast of Scandinavia they seem to have hardly reached the sea, as was pointed out by Sir Henry Howorth (40 *a*, p. 709), but on the Swedish coast icebergs were detached from the glaciers as soon as they reached sea-level. As the current at first flowed from north-east to south-west, the icebergs travelled in that direction, and many were stranded, as we know from the occurrence of Scandinavian boulders in the British upper Pliocene deposits, on the east coast of England. When the level of this North European Ocean rose to a sufficient height to join, by means of several straits, the Ponto-Caspian Sea, a current would naturally flow in that direction, as I have already explained (p. 456). We have evidences of this current in the so-called Glacial striæ which are occasionally visible on the underlying rock. Prof. Geikie tells us (35 *a*, p. 474) that in Finland, and the adjacent tracts of Russia, two systems of Glacial striæ are apparent. The striæ of the older system run in parallel directions, and extend far east and south-east of the terminal moraines, the younger system crossing the other at various angles. Again (p. 426), he remarks: "At Rüdersdorf (Berlin), there are two sets of striæ, one set trending towards south-east, the other and later series being directed towards the west." In speaking of the boulder-clay of Northern Germany generally, he says (p. 463): "There is usually a well-marked distinction between the boulder-clays of the lower and upper diluvium. The former are generally tougher and more abundantly crowded with stones and boulders—the colour of the clay being often dark gray or grayish-blue. Moreover, the included erratics have travelled in directions which do not correspond to those followed by the stones and blocks in the upper boulder-clay."

A persistent current, however, carrying icebergs, laden with detritus in an already turbid sea, would have the inevitable result of preventing any tender marine organisms, such as mollusca, from settling down in its track, and to this fact, I think, is due the absence

in the Russian boulder-clay of organic remains, though the free-swimming larvæ of Arctic mollusca must have been present in this sea which deposited the boulder-clay.

Throughout the German boulder-clay we have evidence that small colonies of molluscs were able, here and there, to find sufficiently sheltered localities, where, perhaps, for a few generations they could survive the discomforts arising from the turbidity of their new home.

Prof. Jentzsch (43) discovered in Eastern Prussia no fewer than ninety such localities of shells; but in the majority of them he found Arctic, North Sea, and freshwater mollusca, equally mixed. The mean thickness of the boulder-clay is about 200 feet, and more than half of this consists, according to this author, of stratified aqueous strata. Prof. Jentzsch (p. 669) thinks that the occurrence of freshwater shells points to the existence of islands free from ice during the diluvial period. From the point of view I have adopted, viz. that the boulder-clay is a marine deposit, it seems to me that the occurrence of freshwater shells, along with marine forms, indicates changes in the salinity of the North European Ocean. When the waters became more brackish, many purely freshwater species would migrate to the ocean from the coast; and, as at the present day, *Tellina balthica* and *Cardium edule* live side by side in the Baltic, with such freshwater forms as *Limnæa lagotis*, *L. ovata*, and *Neritina fluviatilis*, it is not impossible to suppose that *Valvata piscinalis*, *Paludina diluviana*, and *Dreyssensia polymorpha*, which were the principal species found by Prof. Jentzsch, actually inhabited the ocean for some time during its existence.

The occurrence of *Dreyssensia polymorpha* in the German boulder-clay is particularly interesting. It suddenly makes its appearance in the German lower boulder-clay, but then entirely disappears again, and is not known from the subsequent more recent deposits.[1] In the

[1] This species is unable to exist in water containing more than a certain percentage of salt. It does not even occur in the southern part of the Black Sea, and, of course, is quite absent from the Mediterranean, the Atlantic, and the German Ocean. It is now found in canals and slowly-flowing rivers in Northern Continental Europe and in England. It is supposed to have suddenly appeared in England in 1824, and though the late Dr. Gwyn Jeffreys (42) denied that there was any foundation for such a supposition, it is still quoted in text-books as an artificially introduced species. So deeply rooted, indeed, is that belief, that even the recent discovery by Mr. Woodward (94, p. 342) of some specimens in a post-Pleistocene deposit in London, fifteen feet below the surface, has not effected a change, and conchologists persistently cling to the favourite hypothesis which offers such a vast field for pleasant speculations. It is almost certain, however

lower boulder-clay, moreover, it becomes rarer as we go west, being most abundant in Eastern Germany. When we take into consideration that the original home of the genus Dreyssensia, and of its ancestor Congeria, is the Caspian (65), the natural inference from the fact of its sudden appearance in Northern Germany alone seems to me sufficient

6.—Map showing the land-connexion between Europe and Greenland during Interglacial times, and the manner in which a way was opened to Europe from Asia by the recession of the sea. The light parts represent the land at that time; the shaded ones the sea.

to conclude that there must have existed some communication between the North European and the Caspian Seas at the time when the boulder-clay was deposited. As we have seen in the preceding pages, many other facts point to the same conclusion. Again, its non-appearance in the upper boulder-clay and the more recent deposits of Northern

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that *Dreyssensia polymorpha* survived in Northern Europe in some isolated lakes ever since the deposition of the lower boulder-clay, and only spread with such rapidity in recent years owing to the introduction of canals. The larva being a free-swimming one, the species cannot exist in rapidly-flowing rivers.

Europe shows, not only that it died out owing to the conditions in the North European Ocean becoming unfavourable to its existence (no doubt, owing to the sea growing more salt), but that the communication between the two seas ceased to exist, preventing further migration.

We can show clearly then, as pointed out before, that a land passage was opened up between the shores of the receding Northern Sea and those of the Ponto-Caspian, enabling the Siberian fauna to enter Europe.

On the accompanying map 6 are shown the probable geographical conditions of Europe at this time. The land-surface, which separated the Ponto-Caspian from the North European Sea, formed the bridge, by means of which the Siberian migrants crossed over to Europe. Long before this event took place, it had been a land-surface, but the sea, as we have learned, had broken through it in several places, thus forming an impassable barrier to the Siberian fauna. As the Northern Sea retired during Interglacial times, the bridge became passable again.

The origin of this land-surface has long been a source of many elaborate geological speculations. It occupies a vast region in Southern Russia between the Carpathian Mountains and the Ural, and has a world-wide fame, being known as the Black Earth of Russia, or "Tchornosjem." Murchison (59) believed it to be a marine silt, derived from the black Jurassic shale of Northern Russia. More recently, after a careful chemical analysis, Mr. Ruprecht (73) demonstrated that this black earth had been produced chiefly by the decomposition of tufts of grass, no roots of trees or of bushes having been found in it. We may assume, therefore, that this tract of land, over which the Siberian fauna wandered, consisted of a vast prairie. On their arrival in the more central parts of Europe, the Siberian Mammals spread into Austria, Hungary, and Northern Italy, throughout the greater part of Germany and France, and into England (see map, p. 448). They scarcely touched any part of Southern Europe, and their progress in France was apparently arrested by the Garonne, as no typical Siberian forms are found fossil south of that river in the Pyrenees or in Spain. Of course, more recently the Siberian survivors in Europe have spread not only into Southern Italy and Spain, but also throughout Great Britain and Scandinavia. But, as previously stated (p. 448), none of them entered Ireland, and I have given this as one of my reasons for the belief that this country became separated from England about the time when the Forest-bed was laid down, and has never been since joined to it.

It is evident that during the deposition of the Forest-bed, the south of England was joined to France. But the two countries must have been united for a considerable time previously, and this is quite in accordance with the opinion expressed by geologists. Mr. Jukes-Brown (46, p. 347) believes that in early Pliocene times there was an Eastern Sea or German Ocean which spread over a portion of Southern England, but that there is no proof of the existence of an English Channel. Again (p. 350), he remarks: "It is tolerably certain that in Miocene time the whole of England and of North-eastern France, with the intervening channel area, was land." In later Pliocene times, the channel was still closed, according to a map (p. 358) which he gives us of the geography of that period.

Quite recently, Mr. Dollfus, of Paris, who has made this subject his special study, communicated a note to the British Association (25, p. 690) agreeing in all essentials with the views expressed by Mr. Jukes-Brown. England, he says, was always in direct continental communication with France during Pliocene time; the English Channel was not open at all.

As regards the Scandinavian peninsula, the total absence of Mammalian remains in Pleistocene deposits indicates that this country was not connected with the Continent during that period.

The presence, on the other hand, of Mammalian remains in more recent deposits, chiefly in Southern Sweden, implies that toward the end of the Glacial Period, a land passage must have existed between North-western Germany and Sweden across Denmark. In referring to the absence of fossil elephants and other large Mammals from the Scandinavian Pleistocene strata, Prof. Pohlig (69, p. 314) expresses the belief that Scandinavia must either have been hardly free from ice during the whole of the Glacial Period, or, if free from ice during Interglacial times, it could then only have had an imperfect connexion with the Continent. That of these alternatives the former was not the case will be proved in the next chapter, and if, as I believe, the bulk of the fauna and flora survived the Glacial Period in the country itself from pre-Glacial times, there is no necessity for supposing that any connexion existed between the Continent and Scandinavia in Interglacial times.

The Arctic Migration.

The animals belonging to the Siberian migration did not reach Ireland, as I have shown in the last chapter, but the effects of a migration which undoubtedly did, and which preceded from the north—

either from Scandinavia or from the Arctic regions—must now be considered. On p. 429, I have referred to the fact that both the fauna and flora of Ireland included an Arctic element, and I may also mention that these Arctic plants and animals are generally confined to the northern and western parts of the island, as if some barrier had prevented their migration along the east coast, or to the central plain, or as if they had been exterminated there in more recent times.

Three of the Irish Mammals, one of which, the reindeer, is now extinct, appear to me to have come direct from the north. Several birds, among the most striking of which may be mentioned the grouse (*Lagopus scoticus*), have formed part of that northern migration. All the Salmonidæ have come to us from the north, whilst a still more noteworthy example of a northern migrant is the stickleback (*Gasterosteus aculeatus*). The land-shells *Helix lamellata* and *Vertigo alpestris*, the beetles *Pelophila borealis, Dytiscus lapponicus, Blethisa multipunctata*, and the moth *Crymodes exulis*, all belong to the same migration. No doubt these and the North American freshwater sponges which have been recently discovered on the west coast by the Royal Irish Academy Fauna and Flora Committee (37) have found their way to Ireland along an old land connexion which formerly united that country with the Arctic regions. In the latter may have originated many of these forms, as well as the plants referred to on page 429, and have migrated to both the Old and the New World. Of course I have selected only a few of the more prominent examples. As our knowledge of the geographical distribution of the species, which is as yet in its infancy, increases, many other of these northern forms will no doubt be discovered in Ireland.

If we cross over to Scotland, we find a very large increase of typically Arctic species of animals and plants, and as these are absent from England, or confined to the northern counties, there can be no question as to their having migrated direct from the north to Scotland by a former land passage. It may be urged that these Arctic species have spread over the plain of Europe, have then entered England from the south, and have subsequently been exterminated, except in their most northern stations in the British Islands. But whilst we have only very slender geological evidence that such might have been the case; there is, I think, strong evidence for the belief that, until comparatively recent times, Norway and Scotland were joined (45, p. 1008), so that animals and plants had no need to migrate by that enormously circuitous route by way of Denmark, Holland, Belgium, and England, and across the many large rivers,

which would have impeded their journey. In Scandinavia, Arctic animals and plants form a large proportion of the fauna and flora, and as we proceed northward, southern forms become more and more scarce. According to Mr. Peterson, no less than thirteen species of Arctic Lepidoptera occur in Northern Europe and North America, but are absent from Asia, and he assumes the probability of a direct land connexion between the two countries by way of Greenland before the Glacial Period, and a survival of these in Europe (67, p. 57).

My assumption that the Arctic element of the fauna and flora, which undoubtedly exists in the British Islands, and which is now confined more or less to the northern parts of Great Britain and Ireland, migrated by a direct route from Scandinavia, is not founded on geological data alone, but has been suggested to me in a great measure by the present range of the Arctic species. Let us take some examples. I have referred to three species of Mammals, viz. the hare (*Lepus variabilis*), the stoat (*Mustela erminea*), and the reindeer (*Rangifer tarandus*), which I suppose to have migrated to Ireland directly from the north, or more correctly the north-east, and it is essential that I should dwell on the history of each of these for a little, as their past range is so much better known than any of the other members of the Arctic migration which we have to deal with.

Lepus variabilis.—To those who are not acquainted with the fact, I may mention that this hare is the only one inhabiting Ireland, and that it lives in the plain as well as in the mountains. In Great Britain it is confined to the mountains of Scotland, whilst the plain is inhabited by the European hare (*Lepus europæus*), which, I have shown, came originally from Siberia. *L. variabilis* is found on such widely separated mountains as the Pyrenees, Alps, Tatra, Caucasus, and the Akita and Mioko-san mountains in Japan, whilst quite absent from the plains surrounding them. It is perfectly clear that at some time or other it must have inhabited these plains, but it has since disappeared from them, thus producing discontinuous distribution, which, as I have already stated, is a proof of antiquity. Besides, the vastness of the range alone indicates this, and its migration southward must have taken place at a very remote period. On the continent of Asia and North America it is confined to the northern parts. In Northern Europe we find it in Scandinavia, and almost everywhere in the Arctic regions. Its home is therefore in the north; During the Glacial Period it is supposed to have been driven south, and its occurrence in the Caucasus, the Alps, and the Pyrenees is looked upon as a standing testimony to the extreme refrigeration of

the climate, for when the cold passed away, the plain is believed not to have suited the hare any more, and it retired to the more congenial atmosphere of the mountain tops. This view, first promulgated, I think, by Edward Forbes, has been almost universally adopted (see p. 449). Certainly, as Darwin has remarked (p. 21 *a*, 331), it explains the presence of Arctic forms on the Alps and other mountains in a most satisfactory manner. Still, I venture to think the Glacial Period did not play so important a rôle in the present distribution of the Arctic hare. We need only look at Ireland and at Sweden. In both countries this hare inhabits the plain as well as the mountains. Moreover, it flourishes in the former country where there is hardly any snow, and where the temperature in winter approaches that of Southern Europe. It seems to me unlikely, therefore, that this hare should have left the plain of Central Europe and France, on account of the passing away of the cold, and we must seek for other causes to explain its peculiar geographical range. The European hare (*Lepus europaeus*) never lived in Ireland, but it did inhabit Sweden, where it is now extinct. Attempts have been made in both countries to introduce it, but without success. On the other hand, we find it stated, in the "Zoologia Danica" (97), that, in severe winters when the Sound between Southern Sweden and Denmark becomes covered with ice, the Arctic hare migrates across to the latter country. Nevertheless, although this migration must have taken place on very numerous occasions for centuries past, it has never been able to settle down in the country, whilst the European hare thrives there. Both hares can stand extremes of temperature perfectly well, but their range does not overlap anywhere, and their distribution seems to me to indicate that the two species will not live together. The European hare being probably the stronger of the two, has driven the other out of the European plain into the mountains, whilst in small colonies, as in Ireland and Sweden, it may be overwhelmed by the superior numbers of the enemy. Not the change of climate, but the sudden advent of a strong rival from the east probably confined the Arctic hare in Central Europe to regions where, owing to the superior adaptability of its fur to changes of colour, it still reigns supreme, as a survival indeed, but not of an Arctic climate.

As I mentioned before, the Arctic hare is undoubtedly a very ancient species and must have inhabited Europe before the European hare made its appearance there. Had they arrived at the same time from the east, there is no reason why both should not have reached Ireland. The Arctic hare probably entered Asia from North America

across the old Behring Sea connexion. It could not have come from Asia before the European hare, as I have clearly demonstrated (p. 453) that a barrier kept back the Siberian fauna. The only way it could have entered Europe is from the north, its original home. I shall bring forward evidence to show that Scandinavia and Spitsbergen, were connected before and during the Glacial Period (see also page 462). I believe that the Arctic hare migrated along that land to Scandinavia, and then to Scotland and Ireland, which were at that time all united, that is to say, in pre-Forest-bed times, when Scandinavia, as I have mentioned, was not directly connected with continental Europe (see map, p. 461). It then spread into England, where its remains were found in the Mendip Hill Cave (not in any true Pleistocene deposits) and subsequently to the Pyrenees and Alps.

Mustela erminea.—The well-known fact that the stoat, like the Arctic hare, generally changes its fur to white in winter, is suggestive of a northern origin. Even in Ireland both species often become partially white in the winter months, though there may be little or no snow on the ground.

Its absence from the Mediterranean region and from Portugal and Southern Spain proves, that it did not enter Europe from the south. We have learnt (p. 447), that the stoat came with the weasel and polecat from Siberia, and with them invaded England, after having traversed the central plain of Europe, but, as I have stated before, I consider it improbable that, of the Siberian immigrants, it almost alone should have reached Ireland. Still the stoat undoubtedly did migrate to Ireland. When we consider, however, that the Irish stoat is very distinct from the ordinary English and continental form, so much so, that Messrs. Thomas and Barrett-Hamilton have recently raised it to the rank of a distinct species (86), the view that it belongs to a different migration will perhaps be more readily accepted. The stoat is certainly of northern origin, and it is one of the few Mammals which still inhabits the Arctic regions. It has been observed in Grinnel Land, Greenland and Spitsbergen, so that provided a land-passage existed connecting the latter with Scandinavia, it could easily have entered Europe direct from the north. It spread from the Arctic regions to North America, and from there into Asia, being still found on the islands of the Aleutian chain (36) which used to form the highway between the two continents. A branch of the Asiatic stock even penetrated into Northern Africa (85), possibly by way of Greece and Southern Italy, though not found in Southern Europe at present. But this Algerian form is, as Mr. Oldfield Thomas mentioned to me,

more closely related to the typical European than to the Irish stoat, so that any near relationship between the African or the Asiatic forms and the Irish is excluded.

Rangifer tarandus.—Two distinct races of the reindeer, viz. the large Woodland and the smaller Barren-ground caribou, have long been distinguished in North America. In the latter the antlers are more rounded and slender than in the other race.

If we turn to the Old World we find that two very similar races occur, but whilst both inhabit Europe, one only, viz. the Woodland form, lives in Asia, and there is no record that the other existed there. This startling fact suggests that the Barren-ground caribou has either come to Europe from America by a different route from that of the other race, or that it has originated in the Polar regions, and thence spread to America and to Europe from its original home. But whatever view we adopt, the present geographical conditions could not have prevailed when these migrations took place, and an extensive land connexion between Northern Europe and the Polar regions must then have existed. That such a connexion did actually exist, is proved by the occurrence of the reindeer in Greenland, Melville and Disco Islands, and Spitsbergen. However, if we had not this proof, the mere knowledge of the distribution of the fossil remains of the reindeer in Europe would render it highly probable. In Ireland alone of all the countries in the Old World do we find only the remains of the Barren-ground reindeer. In Great Britain the two forms occur mixed. The Scandinavian reindeer is also the Barren-ground form, but the Lapland race is intermediate between the two. On the Continent the Barren-ground reindeer is entirely confined to Western Europe, and it seems to occur there in older deposits, as a rule, than the other race.

All this clearly points to a double migration of the reindeer to Europe—an older one of the Barren-ground race from the north, and a more recent one of the Woodland race from the east. The known facts of the present and past distribution of the two races perfectly agree with this view. The Barren-ground reindeer occurs in Greenland and Spitsbergen; then, again, as we have seen, in Scandinavia. It migrated along an old land-connexion to Scandinavia at a time when that peninsula formed not a part of the Continent of Europe, but an elongated isthmus which stretched south from Spitsbergen, which latter again was joined to Greenland. The reindeer then invaded Scotland and Ireland (see map, p. 461), and crossed over into France, where it penetrated as far as the Pyrenees. It is, as

Mr. Harlé has pointed out (38), the only Arctic Mammal of which remains have been discovered in these mountains. It is even possible, Mr. Harlé thinks, that some bones which he obtained in the province of Gerona, in the extreme north-east of Spain, may be referable to the reindeer. The important fact, as has already been referred to by Lartet (55), is that these French reindeer remains belong to the Barren-ground race, whilst Gervais has shown (see Beyer, 7, p. 68) that those from Northern France agree with the ones from the Central European deposits, and belong to the Woodland form. Then, again, Dr. Beyer informs us (7, p. 68) that, in one of the oldest Pleistocene deposits of Germany, at Rixdorf, all the reindeer remains belong to the Barren-ground race. All these remains of the Barren-ground reindeer occur either in caves or in early Pleistocene deposits. Indeed Struckmann (81, p. 764) quite recognizes that in Southern Europe (Pyrenees) the reindeer is found, as a rule, in older strata than in the more northerly localities.[1]

Struckmann (81, p. 766), and also Woldrich (93, p. 124), believed that, as far as Europe is concerned, the reindeer entered it from Asia; but Mr. Bogdanov felt that a distinct northern migration, which eventually reached the Pyrenees, and among which was the reindeer, must have originally issued from Scandinavia (9, p. 26). The latter view harmonises with my own, in so far as that I agree with him that one of the races entered Europe from the direction of Scandinavia; and this is really the principal point at issue.

It is a well-known fact that reindeer are in the habit of travelling considerable distances on ice; and it might be urged that it had traversed the distance from Spitsbergen to Norway during the Glacial Period, when the sea in these northern latitudes was supposed to have been frozen over, or covered by a huge glacier. Extensive land-connexions are assumed by some geologists to have existed in the Arctic regions after the Glacial Period, by means of which the fauna and flora are supposed to have migrated north again, after having been driven south by the cold.[2]

[1] He, no doubt, has the German deposits in view—not the British or Scandinavian.

[2] A natural sequence of my views is that there must have been a survival of a considerable fauna and flora throughout the Arctic regions during the Glacial Period. Even Prof. Nathorst admits (61 *a*, p. 200) that a small portion of the pre-Glacial flora might have persisted through the Glacial Period, whilst Mr. Warming (90) maintains that the main mass of the present flora survived in Greenland, and that the remainder have been accidentally introduced by birds and winds. Few naturalists, however, are more intimately acquainted with the Arctic regions than Col.

It seems to me that such a supposition is entirely unwarranted from the known habits of the reindeer and its powers of endurance. The distance which it would require to traverse between Spitsbergen and the most northern point of the Scandinavian peninsula is at least 700 miles, though Bear Island, which is about 250 miles south of the former, might form a resting place. To travel in search of food on such exceedingly difficult ground as rough ice with crevasses for even a couple of hundred miles would have been quite beyond its powers.

There are in Ireland a few American species of plants, and also some Invertebrates which in Europe only occur in the west. They are altogether absent from Eastern Europe and from Asia. It seems to me probable that these have migrated during later Tertiary times, either from North America by means of the former land-connexion which I have referred to, or from the Arctic regions to both Europe and America, and thus form part of the Arctic migration. In Ireland these so-called American species are almost altogether confined to the northern and western counties.

The first of these, a pretty white-flowering orchid (*Spiranthes romanzoviana*), does not occur anywhere in Europe outside Ireland. Until recently it had only been met with in a few isolated localities on the west coast, but Mr. Praeger has since added another station in the north of Ireland (Co. Armagh). The second is the narrow-leaved *Sisyrinchium anceps* which is found in boggy and heathy places in the counties of Galway and Kerry. It has not been met with anywhere else in Europe. The next two, viz. the slender Naiad and the jointed Eriocaulon are freshwater plants, and have a somewhat wider range than the others. The Naiad (*Naias flexilis*) is found in Connemara, in the west of Scotland, and in a few isolated localities in Northern

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Feilden, and he is certainly in favour of a survival of part of the plants through the Glacial Period, where they now live (29, p. 50). Mr. Geldart expressed similar views in an interesting address, recently delivered to the Norfolk and Norwich Naturalists' Society.

The idea that everything within the Arctic Circle was covered by snow and ice during the Glacial Period can no longer be maintained. Some, indeed, hold that the climate in those regions was then much milder than it is now.

Col. Feilden remarks (30, p. 57): "It is suggestive that all the Glacial deposits which I have met with in Arctic and Polar lands, with the exception of terminal moraines now forming above sea-level, in areas so widely separated as Smith's Sound, Grinnell Land, Northern Greenland, Spitsbergen, Novaya Zemlya, and Arctic Norway, should be glacio-marine beds. Throughout this broad expanse of the Arctic regions I have come across no beds that could be satisfactorily assigned to the direct action of land-ice."

Continental Europe, whilst the Eriocaulon (*Eriocaulon septangulare*) occurs on the north and west coasts of Ireland, and on some of the islands off the west coast of Scotland.[1] All these species of plants, as I mentioned, are commonly distributed in North America.

Among animals no doubt a good many similar examples occur, though probably few of such very restricted range. I have already referred to the common stickleback (*Gasterosteus aculeatus*), which is found in Greenland, North America, and Europe, but is quite absent from Asia, though an allied species inhabits Kamtchatka. The nine-spined stickleback (*Gasterosteus pungitius*) is confined to Western Europe and North America, whilst an allied species (*G. sinensis*) lives in China, and has probably penetrated there from the New World across the old Behring Straits land-connexion. Europe has many land and freshwater mollusca in common with North America, also many butterflies, moths and beetles, but the Asiatic distribution of the insects generally is not sufficiently well known to permit us to definitely assert their absence in Asia. The freshwater sponges of Central and Northern Europe have been fairly well worked, and it must be surprising to many to hear that we possess in Ireland three North American species which have not hitherto been discovered elsewhere in Europe or Asia. These three, viz. *Ephydatia crateriformis*, *Heteromeyenia Ryderi*, and *Tubella pennsylvanica*, were recently described by Dr. Hanitsch (37, p. 125) in the "Irish Naturalist." They all inhabit lakes on the west coast of Ireland.

The spider (*Porrhomma myops*), which was discovered by Mr. Carpenter in Mitchelstown Cave in Ireland (16 *c*), is, as he remarks, probably identical with a North American species, and in Europe is confined to the west. I think all these instances of a close relationship between the European—and chiefly Western European—and the North American fauna and flora are to be explained by a former land-connexion between these two continents in the manner described on p. 462 (see map, p. 461).

Many eminent geologists have held that the Glacial Period was produced by a rising of the land in the Arctic regions. Sir Charles Lyell was an adherent to that theory. Professor Dana suggested that an elevation of the Arctic land sufficient to exclude the Gulf Stream, might have been the source of cold during the Glacial Period (20, p.

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[1] Two additional North American plants, viz. *Juncus tenuis* and *Polygonum sagittifolium*, have recently been discovered in the west of Ireland by Dr. Scully, and one (*Sisyrinchium californicum*) by Mr. Marshall on the coast of Wexford ("Irish Nat.," 1896).

540). He adds (p. 542): "If the cause of the Glacial cold was connected with the closing of the Arctic regions against the tropical currents of the Atlantic, the North Atlantic Ocean would have had greater warmth than now, and this would have produced unusual evaporation, and hence unusual precipitation on its cold borders." Croll, on the other hand, in referring to this barrier of land, says: "I have never been able to find any evidence that any such barrier did exist during the Glacial Period."

In a Paper on the history of the vegetation of Greenland (61 *a*, p. 185), Prof. Nathorst speaks of Spitsbergen as a northern continuation of Europe—not only geographically, but also botanically and geologically. All the flowering plants of Spitsbergen, with the exception of but three species, are also found in Northern Europe and Novaya Zemlya. He is of opinion that Spitsbergen must have been partially connected with Europe during the Glacial Period. On the other hand, the occurrence of a number of American plants on the west coast of Greenland seems to point to a former land-connexion between the latter country and North America. Prof. Engler observes (26, p. 12) that, as Spitsbergen, Franz-Joseph's Land, and Novaya Zemlya lie on a sub-marine plateau which is less than 200 fathoms below sea-level, and is probably continued northward, the insular position of these islands might only be a temporary one. These islands might, he says, have formed a connexion between Greenland and Arctic Europe, by means of which a migration of plants from North America and Greenland to Northern Europe became possible. At any rate, he continues, the reasons in favour of this Arctic connexion of America with Europe are stronger than those of a connexion between Greenland, Iceland, the Faroes and Great Britain. He thinks too (p. 143) that many species of plants belonging to the Alpine flora of Arctic Siberia seem to have travelled from Scandinavia *via* Greenland and North America to Eastern Asia, and not direct from Scandinavia to Siberia. Among Irish naturalists I may mention the late Dr. Moore and Mr. A. G. More, who were both of opinion (58, p. xx.) that the presence in the west of Ireland of several American plants indicated a former land-connexion between Europe and North America.

The most important geological contribution which has been published on this problem of a former northern land-connexion is that by Professor Petterson (68). He tells us that, according to recent surveys, a high sub-marine plateau, with a sharp fall of 1000 fathoms towards the Atlantic Ocean, rises from Northern Norway, and continues as far as Spitsbergen. From this plateau arise several

islands, such as Bear Island, King Charles' Land, and others, which must be looked upon as the remains of a much larger mass of land. The sea has broken through and diminished this land considerably in the course of time, as is very evident in the case of Bear Island.

In referring to a number of shallow-water mollusca, common to the coast of Greenland and Finmark, the late Prof. Forbes said (33*b*, p. 56): "that these littoral mollusks indicate, by their presence on both sides of the Atlantic, some ancient continuity or contiguity of coast-line, is what I firmly believe. The line of migration of most of these shell-fish was most probably from west to east, from America to Europe, during a different state of physical conditions from those which now prevail on our side of the ocean." It was probable, therefore, that a current existed in the Arctic Ocean, from west to east, and this offers an explanation for the very remarkable and sudden appearance of no fewer than eighteen American species of mollusca in the newer crags of the east coast of England. In the last chapter, p. 461, I explained how the German Ocean was connected with the White Sea across Northern Russia, at a period which certainly antedated that of the Forest-bed; and that was, no doubt, the way in which these mollusca above referred to, which had been brought to the White Sea by the westerly current, reached the east coast of Britain. Had they come straight across the Atlantic from America, we should find some traces of them in such beds as those of St. Erth, in Cornwall, which is probably of about the same age as the newer crags. But Messrs. Kendall and Bell (49), who have studied these deposits carefully, do not report the occurrence of any of these American forms, while, from the absence of Arctic species, they are led to think that the Arctic Ocean did not then open into the Atlantic. They suppose that a land-communication must have existed between Europe and America, so as to form a barrier of separation between the Arctic and Atlantic Oceans.

I think it has been clearly shown that a former land-connexion must have existed between Scandinavia and Greenland on the one hand, and between Scandinavia and the British Islands on the other, and that it formed the highway for an extensive migration from the north, and *vice versa*. Most naturalists, indeed, admit this, but many deny that it could have been anything but post-Glacial. I believe that the migration took place chiefly in later Pliocene times, *i.e.* during the deposition of the newer crags and of the lower continental boulder-clay. The Arctic animals and plants certainly reached the British Islands long before the Siberian immigrants. Throughout the

Glacial Period (inclusive of the period when the newer crags were deposited) the White Sea remained connected with the Baltic and the German Ocean, forming the great sea which I ventured to call the North European Sea (p. 462). Long before the Arctic migration reached the British Islands, another migration advanced from the south; first, as I explained, from South-western Europe, and, as the climate became colder, from Southern and Central Europe. Many of the animals and plants which arrived with the latter straggled northward into Scandinavia, and even at the present moment they seek to extend their range in a northerly direction. There is no evidence that their progress was checked by the Arctic climate, which is supposed to have prevailed during the Glacial Period; but this subject will be dealt with more fully in the next chapter. As I have given a detailed account of the nature of the southern migration in a paper recently published in France (76*c*), it will be found sufficient to merely repeat the salient features, and add a few instances of distribution not previously recorded.

The Southern Migration.

I have already mentioned (p. 429) that the bulk of the Irish fauna and flora belongs to this migration, and that we can divide its members again roughly into those of South-western and those of Southern or Central European origin. But, in reality, the origin of this migration is an exceedingly complex one, and is all the more difficult to trace, as migrations from the south to the north have apparently proceeded uninterruptedly during many of the past geological epochs—certainly during the whole of the Tertiary Era. Whilst most of the larger and short-lived forms have died out again, some of the less conspicuous Invertebrates are undoubtedly of very ancient origin, and have witnessed vast changes in the fauna and flora surrounding them. Many of these, though their general distribution indicates a southern origin, baffle all attempts at solving the problem of the location of their ancestral home. In some respects the southern migration merges into the Siberian one; for there are a good many English species of animals and plants which, though absent from Ireland, belong certainly to the former. The dormouse (*Muscardinus avellanarius*), for instance, is probably of Central European origin; but it nevertheless is absent from Ireland. Its general range, however, proves that it is of very recent origin, and it has only spread from its original home, which may be in the Alps, after Ireland was already disconnected from Great Britain. It has never reached Scotland, Spain, Norway,

Russia, Greece, or any of the Mediterranean islands, except Sicily, where it is present, according to Döderlein (24). Then there are forms which, though they have come to the British Islands from Southern Europe, have probably not originated there, but in Central or Southern Asia. Certain of these Asiatic species have joined what I call this "*Southern Migration*," but subsequently they have invaded Europe along with the Siberian migration. In most of these instances, however, the members of the earlier southern migration belong to a different variety from those of the later one, or exhibit such racial characters, that naturalists are able to distinguish them from one another, and thus differentiate between the two migrations. On p. 452, I referred to two of such cases, viz. those of the European hare and the bullfinch, and I shall mention others directly.

I have more than once drawn attention to the important rôle played by the land mollusca in elucidating former changes of land and sea. The mollusca of islands are of great importance in studying geographical distribution. A knowledge of the molluscan fauna of such islands as Ireland, Sardinia, and Corsica will help us to solve many of the problems associated with their former continental connexions. Especially is this the case with the slugs. As the sea forms an impassable barrier to slugs, being deadly both to themselves and their eggs, the occurrence of the same species on an island and the adjoining mainland, proves that these were formerly connected by land.

The chief centres of the creation of species in the Holarctic region are all in southern latitudes, as Dr. Simroth has pointed out (77, p. 20). One active creative-centre lay, according to this learned malacologist, in South-western Europe, another in the Caucasus. This agrees perfectly with the data which we possess of the geographical range of slugs. For instance, the genus Arion undoubtedly originated in South-western Europe. Most of the species are still confined to the Spanish peninsula, and if we proceed south, east, or north, the number of species gradually decreases, and outside Europe and Northern Africa the genus is quite unknown. If we suppose the French west-coast to have been continued north as far as the Irish, an Arion, proceeding to migrate from its original home in South-western Europe, would have had about as far to go to Ireland as to Germany, and, indeed, an equal number of species inhabit both countries. But in the more distant Russia, Scandinavia, and Turkey the numbers of species of Arion are much fewer.

Then we have the peculiar genus Geomalacus almost confined to the Spanish peninsula, which genus, owing to its discontinuous distri-

bution, must be looked upon as an ancient one. There are about three or four Portuguese species, one of which, *Geomalacus maculosus*, migrated as far north as Ireland, and has survived there, though it appears to have become extinct in the intermediate tracts of country, which it, no doubt, once inhabited. Testacella is another typically Western European genus, and it is of exceptional interest from a distributional point of view, owing to its subterranean habits. There are about a dozen species, of which three have reached Ireland, while none occur in Central or Eastern Europe. The close relationship between the South-west European molluscan fauna and that of Ireland is altogether very striking, but, as I have had occasion to mention, there is no need of invoking a direct former land-connexion between that country and Spain, as has been done by the late Prof. E. Forbes, in his classic memoir, in attempting to trace the origin of the Irish flora (33*a*). An indirect connexion between Ireland, the west of England, and France, which has so often been suggested, is sufficient to explain all the minutiæ of distribution. In every group of Invertebrates, the Irish fauna exhibits strong affinities with France and the Spanish peninsula, certainly much more so than with Germany and Eastern Europe. But in all these cases it might be urged (by those naturalists, especially, who adhere to the view that everything is explainable by accidental introduction) that Ireland, being within easy reach of the Spanish or French coasts, many of these forms were either carried by migratory birds or with floating wood, etc. I will instance, therefore, a case which, I think, cannot possibly be attributed to any of these agencies, viz. that of the blind woodlouse (*Platyarthrus hoffmanseggii*).

The genus of Platyarthrus is confined to Western Europe and Northern Africa, and it has formed such a close alliance with ants, that it never is found outside an ant's nest. One species inhabits Scotland, Ireland, the south of England, and Western Continental Europe, and is always found in the nest of the common red ant. As the nests of these ants are almost invariably under stones, and the woodlouse itself is hidden in the subterranean burrows of its host, the fact of the occurrence of this species in Ireland admits of but one explanation, which is that it migrated to that country when the latter still formed the northern part of France. As the migration of these lowly animals progresses exceedingly slowly, this land-connexion must have been one of very considerable duration. How long it lasted, and especially during what geological epoch it existed, will be considered later on. Meanwhile, we must return to the subject of the southern migration.

Among the birds, which have arrived in Ireland with the southern migration, may be mentioned the Dipper (*Cinclus aquaticus*). It inhabits the Pyrenees, France, the south-west of England and Wales, Ireland, Scotland, and the outer Hebrides, and just enters the western parts of Germany, Holland and Belgium. Unlike the animals considered above, it has not, however, originated in South-western Europe. It has only migrated to Ireland from there, though a race known as *Cinclus melanogaster* may have developed in South-Western Europe and have spread north more recently, for, according to Dr. Bowdler Sharpe, it is only found in the east of England. Beyond the British Isles it is known from Scandinavia and even Northern Russia besides the Spanish Peninsula. A second race (*Cinclus albicollis*) inhabits the whole Mediterranean region, spreading north into Switzerland, and it forms the link as it were between the true Dipper and the Asiatic form, *Cinclus cashmeriensis*. The other species of Cinclus are divided between Asia and America, but the genus is probably of Asiatic origin. The path of migration from Asia into Europe across the Aegean Sea, followed by the Dipper was, as I have mentioned (76*c*, p. 458), the regular route at that time. It remained indeed the only means of communication between the two continents for a long while.

I was under the impression that these same conditions prevailed during the whole Pliocene Epoch and only changed then; but Prof. Charles Depéret is of opinion that the extensive land-connexion which prevailed in the Mediterranean during the Miocene Epoch ceased to exist in early Pliocene times. I have not ascertained the reasons for his thinking that such had been the case, but I presume that he holds the Sicilian Pliocene deposits to indicate that a submergence must have occurred then. I would fain accept the verdict of such a high authority, but as those deposits contain northern species of mollusca, which must have reached the Mediterranean from the Atlantic, I venture to think that their true age has still to be decided, after it is definitely known when these mollusca entered the Atlantic.

The bullfinch (*Pyrrhula europaea*) has a distribution very similar to that of the Dipper, but whereas the latter only took part in the southern migration, a form of the other known as the Russian bullfinch (*Pyrrhula major*) joined also the Siberian migration. Such cases occur again and again, and are most instructive. The ordinary bullfinch inhabits the Mediterranean region and Western Europe. One other species or race, as some prefer to call it, inhabits the Continent of Europe and one the Azores, but all the other seven species are Asiatic. We have here, therefore, another instance of a bird of

undoubted Asiatic origin entering Europe in the south-east, then travelling along the Mediterranean to South-western Europe, and only then turning north along the shores of the Atlantic.

Among the Mammalia, I might mention the red deer (*Cervus elaphus*) as a species which has probably reached Ireland from South-western Europe. Not that I would place its centre of origin in that part of the world, for it almost certainly originated in Asia, but that geographical conditions at the time of its migrations to Europe were such (as I have already indicated) that it had no proper means of spreading over the central and northern portions except from that particular region.

In tracing the present range of the red deer, we have to bear in mind that there are a number of forms very closely allied to *Cervus elaphus*, viz. *C. canadensis*, *C. maral*, *C. corsicanus*, *C. barbarus*, *C. cashmerianus*, *C. affinis*, *C. eustephanus*, and *C. xanthopygus*. Sir Victor Brooke (13) has already referred to the fact that the antlers of *C. eustephanus* cannot be distinguished from those of *C. canadensis*. A great similarity is said by Prof. Nehring (62 *b*) to exist between many of the antlers found in European post-Glacial deposits and the recent antlers of *C. canadensis*; and he is inclined to refer them, along with the large antlered Asiatic *C. eustephanus*, *C. xanthopygus*, etc., to the same species, and with this view Prof. Woldrich agrees (93). Then again *C. maral* is looked upon as a variety of *C. canadensis*, and identical with *C. eustephanus* and *C. xanthopygus*, by Tcherski (88); and there can be no doubt as to the specific identity with *C. elaphus* of *C. corsicanus* and *C. barbarus*.

It seems altogether probable that all these forms are but races or varieties of the red deer (*C. elaphus*). However, in the shape of the antler, we can separate two groups, one with short and the other with long and powerful ones. The former inhabits Northern Africa, the Mediterranean islands, Ireland, and Western Europe generally, graduating towards the east into the larger form which occurs in Asia, North America, the Crimea, and in the Caucasus, but is now practically extinct in other parts of Europe.

Sir Victor Brooke indicated, in his interesting monograph of the Cervidæ (13), that their early ancestors spread probably from the eastern Palæarctic and the Indian regions westward into Europe, and eastward to North America. Of the twenty-two species of Cervidæ confined to the New World, no less than twenty-one belong to Sir Victor Brooke's division of the Telemetacarpi, *C. canadensis* being the sole exception. This fact alone would point to the latter belonging

to a distinct and much more recent immigration into America, which view is supported by its range in that continent, it being confined to the Northern States.

The centre of distribution of the whole *Cervus elaphus* group lies in Central Asia, a fact which had been before noticed by Köppen (53, p. 51), who believed that the more accurate position of this centre was somewhere between the Altai and the Tian-Shan Mountains, just as we have had two migrations from Asia of the bullfinch, so we have had the same number of the red deer. The older one of the small-antlered race passed into Greece and spread along the borders of the Mediterranean, at the time when Corsica and Sardinia were still connected with Sicily and Greece on the one hand, and with Tunis on the other. Arrived in Spain, this small race probably spread north and east. But it is only in the isolated regions, such as Ireland, that this race has been still preserved, for owing to the advent of the large-antlered form in Central Europe during the Interglacial Period, which probably interbred with the older one, we have there a race somewhat intermediate between the two.

I may mention that we have fossil evidence of the great antiquity in Europe of the small race of the red deer. It was found associated in Malta with the pigmy hippopotamus, and an extinct elephant (18), and has been obtained in caves at Gibraltar (57 *a*), in Spain (1 *c*), and Ireland (2). All the animals of the southern migration, which I have referred to in the preceding pages, formed part of an exceedingly ancient stream which issued forth from South-western Europe. As I indicated, they did not all originate there, but the natives of that region were joined by those of Central and Southern Asia, which had wandered to South-western Europe, across ancient land-connexions, by way of Greece, Sicily, and North-west Africa. That the fauna of North-west Africa had come from Europe, and that the latter was not stocked from Africa, has already been maintained by the great palæontologist Rütimeyer (74, p. 42), and by Bourguignat (11).

Owing to the breaking up of old land-connexions across the Mediterranean, and to the disappearance of barriers in other places, the Asiatic stream of the southern migration entered Central Europe by a more direct route than before, and was now joined by animals of Central European origin in its northern course. The south-western animals and plants ceased to migrate north, possibly owing to a refrigeration by slow degrees of the climate, and at the present moment many of the members of that early migration, which reached Ireland, have become extinct; most of the survivors, still holding

their ground in gradually decreasing numbers, discontinue to spread. The older members of the southern migration are therefore in Ireland more or less confined to the south-western counties. Not only are they there in a climate more in accordance with their original habitat, but what is of more importance, the struggle for existence is less keen there, as comparatively few of the later immigrants from Southern and Central Europe have penetrated to that part of Ireland. It must be remembered that these changes went on very gradually step by step. Though the number of the south-western species that migrated north probably grew less as the more eastern forms increased, there can be no doubt that some continued to advance north even after Ireland was separated from England.

We come now to the consideration of the Central European branch of the southern migration. This includes, as we have seen, chiefly species of South and Central European origin, but others of Asiatic origin joined in it. Thus the badger (*Meles taxus*) belongs to the last group. It is undoubtedly of Asiatic origin. Four allied species, *Meles leucurus*, *M. chinensis*, *M. canescens*, and *M. anakuma*, inhabit Asia, whilst two, viz. *M. polaki*, and *M. maraghanus* are known from the Upper Miocene of Persia. That on entering Europe it has not been able to make use of the ancient land-connexions above referred to, is indicated by the fact of its absence from Sicily, Sardinia, and Corsica, as well as from Northern Africa. On the other hand, Greece was still united with Asia Minor at that time, for it is an inhabitant of several of the islands in the Greek archipelago (27).

As examples of the first group might be quoted a number of land mollusca, such as *Helix rufescens* and *H. ericetorum*. Most of the nearest relations of the former are confined to Central Europe, and it does not range to the south-west. The allies of *H. ericetorum* have a wider distribution, and some even penetrate into Western Asia.

If, as I think, it may be taken as an established fact that the south-western branch of the southern migration is the first, and the Siberian migration the last, which reached the British Islands, Ireland must have become disconnected from England during the period intervening between the two. It was, therefore, at the time while the migration from Southern and Central Europe was in progress, that the old land-connexion uniting the two countries was severed. That migration, however, did not stop when the Siberian animals invaded Europe. Again, we find the southern forms joining in with those of totally different origin in their wanderings, just as the south-western fauna and flora joined with the Central European. We still have,

confined to South-eastern England, many of the latest immigrants from Central Europe, such as *Helix pomatia*, *H. carthusiana*, *H. cantiana*, *Buliminus montanus*, and others. A large number of species of plants might be mentioned, and also animals from almost all the groups of terrestrial Invertebrates, which apparently had only reached England before it became disconnected from France, and which are still more or less confined to the south-eastern parts of that country. The majority of these are of Central or South-eastern European origin.

Of the Invertebrates we have little or no palæontological proof of the period of their migration to England. But with the Mammals it is very different. We know that the vanguard of the Siberian migration reached England at the time when the Forest-bed was deposited (see p. 462). Every geologist is acquainted also with the fact of the extraordinary mixture of Siberian and southern types of Mammals contained in this bed, as well as in the succeeding Pleistocene ones, and that it has been established beyond a doubt that they must have then lived together, though their original homes often were situated thousands of miles from one another.

"The occurrence," says Mr. Lydekker (57*b*, p. 310), "of the hippopotamus in association with the musk-ox, glutton, and walrus, presents us with another of the puzzles which almost break the heart of the palæontologist." With regard to the epoch of the English caverns and brick-earths, which are by Mr. Lydekker included in the Pleistocene Epoch along with the Forest-bed, he remarks (p. 300): "The most remarkable feature connected with this fauna is the apparently contradictory evidence which it affords as to the nature of the climate then prevalent. The glutton, reindeer, Arctic fox, and musk-ox are strongly indicative of a more or less Arctic climate; many of the voles (Arvicola), picas (Lagomys) and sousliks (Spermophilus), together with the Saiga antelope, appear to point equally strongly to the prevalence of a steppe-like condition, while the hippopotamus and spotted hyaena seem as much in favour of a sub-tropical state of things." Prof. Dawkins (22*b*, p. 113) thought that this anomaly might be explained by the supposition that in the greater part of Britain the winters were cold and the summers warm, as in the middle of Asia and North America, where large tracts of land extend from the Polar region towards the Equator, and offer no barrier to the swinging to and fro of the animals. In the summer time the southern species would pass northwards, and in the winter time the northern would swing southwards, and thus occupy at different times

of the year the same tract of ground as is now the case with the elks and reindeer. Since, however, as Mr. Lydekker tells us (p. 300), "it has now been ascertained that the remains of both tropical and Arctic forms have been found lying side by side in the same bed, it is perfectly certain that such an explanation will not meet the exigencies of the case."

The land and freshwater mollusca known from the Forest-bed are not Arctic, as one should have expected from the foregoing account of the migrations. According to Mr. Clement Reid (72 *a*, p. 186), of the fifty-nine species now determined, forty-eight are at present living at Norfolk, six are extinct, two are Continental forms living in the same latitude as Norfolk, and the other three are southern forms not now living in Northern Europe. The flora also is not Arctic.

Looking at the fauna of Ireland as a whole, there seems no reason to suppose that the whole of it could not have reached Ireland at or just previous to the time when the Forest-bed was deposited in the manner I have attempted to explain in the preceding pages. But since there is very strong geological evidence to show that a Glacial Period, accompanied by an immense sheet of ice which covered the greater part of the British Islands, succeeded the Forest-bed Period, it is perfectly clear that the present fauna could not have survived it in the country.

Mr. Clement Reid believes that a large portion, probably most, of the native British plants were exterminated during the Glacial Period, to be reintroduced when the climate ameliorated (72 *c*, p. 182). "With glacial conditions in Scotland and the hilly grounds of England and Ireland," remarks Prof. James Geikie, "neither temperate flora nor fauna could have existed in our country" (35 *c*, p. 169). According to Dr. Wallace, the fauna was destroyed during the Glacial Period by a submergence (89, p. 338).

Whether the destruction of the fauna and flora was caused by ice or water matters little. Almost all British geologists and zoologists are agreed that the bulk of the Irish fauna and flora migrated to Ireland after the Glacial Period, because they are somehow or other convinced that it must have been destroyed had it reached the country before that period. I have mentioned before that I do not share these views, and I have shown that the range of species within the British Islands is incompatible with the notion of a repopulation after the Glacial Period. "There are few points," says Prof. J. Geikie (35 *c*, p. 169), "we can be more sure of than this, that since the close of the Glacial Epoch—since the deposition of the clays with Arctic shells

and the Saxicava sands—there have been no great oscillations, but only a *gradual amelioration* of climate. It is *quite impossible* to believe that any warm period could have intervened between the last Arctic and the present temperate conditions, without leaving some notable evidence in the superficial deposits of Scotland, Scandinavia, and North America." In the same way, I think, there are few points we can be more sure of than that the South-western European fauna and flora in the British Islands is more ancient than the Siberian or the Arctic. If Prof: James Geikie were right, it ought certainly to be the other way round. But the evidence as to the climate in the British Islands during the Glacial Period is so contradictory, the very nature of that period is so complex, that few scientific subjects during this century have raised more angry discussions, and none have produced a vaster amount of literature. That I should help to increase the latter still more is to be regretted, especially as the subject is not my own; but having been led by faunistic evidence to regard this vexed problem from a side from which it has hitherto received but little attention, I hope I may be excused for venturing to add my own views to those already known.

The Glacial Period.

With regard to the climate of this period, the views of the various authorities are not altogether in harmony. Those of Prof. James Geikie and Mr. Clement Reid have already been stated. Somewhat similar ones are held by Prof. Nehring and many other zoologists, by Prof. Nathorst and many leading botanists, and also by Prof. Penck and a number of geologists, but still there is a sufficiently wide disparity between their views as to the temperature necessary to produce the enormous increase of glaciers all over the Northern Hemisphere. Prof. Bonney holds that a lowering of the temperature amounting to 18° Fahr., if only the other conditions remained either constant, or became more favourable to the accumulation of snow and ice, would suffice to give us back the Glacial Period (10*b*, p. 373). On the other hand, Prof. Neumayr was of opinion (63, p. 619) that the reduction of temperature in Europe could not have been more than 6° C., which is considerably less than 18° Fahr. The very low snow-line in the British Islands, he thought, proved that even then, under the influence of the Gulf Stream, a comparatively mild climate existed, and in fact that the climatic conditions between the various parts of Europe were about the same as now (p. 619). By comparing the

snow-line during the Glacial Period with that of the present day, Prof. Penck came to the conclusion that during the former, the temperature of the Earth must have been 5° C. lower than it is now (66 *a*, p. 75), whilst Mr. Brückner does not allow that it was more than 3-4 degrees lower. Prof. de Lapparent argues that the decrease in temperature during the Glacial Period was probably caused by an increase of humidity; that humidity indeed was the great factor of the Glacial phenomenon (54, p. 1391). Mr. Falsan believes that the mean annual temperature in France ranged between six and nine degrees C. in Glacial times (28, p. 230). As the latter estimate of temperature is something approaching that of Scotland at the present day, a luxuriant fauna and flora could perfectly well have lived in that country under those thermal conditions. Indeed, Mr. Falsan admits that an abundance of vegetation, such as herbs, bushes, and trees must have flourished in close proximity even to the glaciers (p. 240). There is no doubt that a mild climate is not incompatible with the existence of glaciers. I need only refer to New Zealand, where a semi-tropical vegetation exists in close proximity to glaciers. We are reminded by Prof. Penck (66 *d*, p. 222) that wheat is cultivated close to the Aar glacier in Switzerland, and that even in Norway fruit ripens on the shores of Hardangerfjord, a couple of miles only from the inland ice. But the most remarkable fact in connexion with this subject is that pointed out by Darwin, viz., that in Tierra del Fuego glaciers descend right down to the sea, whilst in the same country evergreen trees flourish luxuriantly. Humming birds may be seen sucking the flowers, and parrots feeding on the seeds of the "Winter's Bark" in lat. 55° 5', that is to say, within two degrees of Tierra del Fuego (21 *b*, p. 176). According to the same author the mean annual temperature of that part of South America is 44° Fahr., whilst that of Dublin is 49°. It is six degrees colder in Tierra del Fuego in winter than in Ireland, and no less than nine and a half less hot in summer.

It has even been been argued by geologists that a large extension of ice and snow is possible without any considerable change in the present climatic conditions. Prof. Whitney remarks (92, p. 38) "that the Glacial Period was a local phenemenon, during the occurrence of which much the larger of the land-masses of the globe remained climatologically entirely unaffected." But there are also adherents to the view that a higher temperature, than obtains at present, reigned during the Glacial Period. Thus the eminent French botanist, Henri Lecoq, maintained (56, p. 15) that the former greater extension of glaciers in Europe was caused by a greater snowfall, and indirectly by

a more active evaporation of water, which must have been produced by a warmer climate.

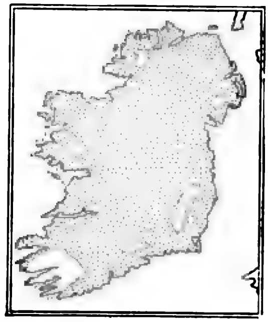
To judge from the above opinions, and taking an average estimate between the extremists on either side, it seems quite conceivable that the present Irish fauna and flora could have survived the Glacial Period in Ireland, if we supposed that perhaps a few local glaciers existed in that country at the time. Such a supposition, however, is altogether denied by Irish and other geologists. Mr. Close believes that practically the whole of the present surface of Ireland was covered by ice—at any rate for some time—during the Glacial Period (17). According to Mr. Kinahan, "it would appear that at one time there was a general south-south-westward movement of a thick sheet of ice across Ireland" (51 *a*, p. 241). Prof. James Geikie informs us (35 *a*, p. 415) that during the epoch of maximum glaciation all Ireland was smothered in ice—only the tops of the higher mountains appearing above the surface of the mer de glace as *Nunatakker*.

That under such conditions no fauna or flora to speak of could have outlived the Glacial Period in Ireland is obvious. As I think, however, that I have brought forward weighty reasons in favour of the present fauna and flora having survived that period in Ireland, we have, in order to uphold my contention, either to suppose that a sufficient former southward extension of land existed on which the animals and plants accommodated themselves during the glacial conditions which prevailed on more northerly parts of the island, or that the views of the geologists as above expressed are erroneous.

If the whole island had been glaciated in the manner indicated, the whole fauna and flora would have had to seek refuge in a supposed southern extension of Ireland. Prof. E. Forbes (33 *a*, p. 14), as I have already mentioned, believed that the Lusitanian element in the Irish flora must have survived the Glacial Period on such a now sunken part of the island, and that afterwards, as more favourable conditions set in, the remnants of it took possession of the south-western counties. It evidently never occurred to Prof. Forbes that the whole of the present fauna and flora might be pre-Glacial, and could have been driven to this submerged land to seek refuge from the ice. But if such an emigration and immigration from and to the present land surface of Ireland had taken place, we certainly should perceive clear indications of it in the composition of the Irish fauna and flora. There is one thing absolutely certain, however, and that is, that the most ancient Lusitanian forms are more or less confined to the south-west, the northern forms to the north and west, and the most eastern

ones to the east and centre. They, indeed, still occupy the tracts where they originally arrived in the country. Had all the animals and plants reached the island from the south-west, where the sunken land is supposed to have been situated, that part would probably be the richest in species, whilst it is in reality much the poorest, and nothing strikes a naturalist more forcibly than the absence there of a large number of the commonest Irish species.

Let us take an example from the mollusca. Four species of Helix, belonging to the subgenus Xerophila, inhabit Ireland, viz. *Helix virgata*, *H. intersecta*, *H. ericetorum*, and *H. barbara* (*acuta*). They rarely make an attempt to hide themselves, are extremely conspicuous, and always occur in abundance wherever found. They inhabit almost the whole of Ireland, but are especially common round the coast. For some years I have carefully collected statistics as to their occurrence, and have specially visited many parts of the coast, and have invariably found one or more of the four species; but the only strip of coast-line in Ireland where they are completely absent is that between Valentia Island and Baltimore—that is to say, all along the Kenmare River and Bantry Bay—the very coast where we should expect them to occur plentifully if the theory of their survival on the southern sunken land were correct. As they presumably entered Ireland from the east, and then travelled both inland and along the coast, it must be surmised that they have not yet been able to colonize the extreme south-west.



7.—Map of Ireland on which the distribution of the Xerophilous Helices is indicated by dots.

That the whole Irish fauna and flora could have survived on a now sunken southern extension of Ireland is, therefore, impossible. They must have remained within the present boundaries of the island during the Glacial Period, though it is probable that it did extend somewhat more to the west, south, and north, then it does now, and that those parts of the country stood at a relatively higher level to the east; so that the Shannon and some other rivers, which now drain into the Atlantic, emptied their waters into the Irish Sea (see 76*a*).

The nature of the Pleistocene Mammalia of Eastern England is not such as to indicate an Arctic climate in the British Islands. The

presence of northern forms is due, as we have seen, to an immigration of Siberian animals; but, as they lived in company with southern types, many of which required an abundance of green food, the winter temperature in the British Islands may have been as high or higher than it is now, though with a lower summer temperature, and with a copious snow-fall in winter, glaciers were generated in the mountainous regions. A number of land and freshwater shells are quoted by Prof. J. Geikie (35 *a*, p. 337), from the Arctic freshwater bed on the coast of Norfolk, in evidence of a rigorous climate. These are spoken of by him as high northern forms; but in this he is mistaken. Every one of them are inhabitants of Ireland at present, and all but one very common.

But if the fauna does not indicate Arctic conditions during the Pleistocene Epoch in the British Islands, we are told that what is known of the flora, at any rate, is such as to exclude the possibility of its existing under anything but an Arctic climate. The same Arctic freshwater bed just referred to contains, besides the shells, some plant-remains, and these, according to Mr. C. Reid, imply a lowering of the temperature by about 20°F. The plants of the Forest-bed, Mr. Clement Reid tells us (72*a*, p. 186), are not Arctic. Though the land and freshwater molluscan fauna remains much the same in the later deposits, the plants alone, it appears, are quoted as indicators of temperature. Prof. Nathorst has made the Pleistocene flora the subject of his special study, and to his writings we must appeal for information on this subject. It appears, from his interesting essay on the distribution of the Arctic plants in Europe during the Glacial Period (61 *b*), that all the localities but one, in which remains of such vegetation have been discovered, lie either within the limits of the maximum extension of what is known as the northern ice-sheet, or within those of the Alpine glaciers. It is conceivable, therefore, that the remains of the vegetation in question were carried down from the mountains by glaciers, and deposited far from where they originally flourished. Such a transportation from a distance is still more easily conceived when we consider that, as has been suggested, the limits of the maximum extension of the Scandinavian ice-sheet merely represent the shores of a North European sea, and that the plants, along with the boulders, have been left by stranded icebergs, where we now find them. The Arctic willow (*Salix polaris*) and the dwarf birch (*Betula nana*), which occur in the so-called Arctic freshwater beds of Norfolk, might have reached their destination from Scandinavia in that manner, without influencing the British climate

very seriously. But it is more likely that these plants lived where their remains are now found, especially since there can be no doubt at all that some Arctic species grew formerly in the south of England. The exception, above referred to by Prof. Nathorst—namely, of a locality where deposits of Arctic plants occur not within the limits of the former range of glaciers—is that of Bovey Tracey in Devonshire. Though the age of this deposit in not quite settled, it does not matter very much. The fact remains, that Arctic plants did here flourish some time or other within a recent geological epoch, and do not do so now. Prof J. Geikie (35*a*, p. 398) remarks, "during the climax of Glacial cold, it is unlikely that Southern England had much, if any, vegetation to boast of." "It is certain, however, that it was clothed and peopled by an Arctic flora and fauna when the climatic conditions were somewhat less severe, relics of that flora having been detected at Bovey Tracey."

The Arctic plants that have been discovered there comprise *Betula nana* and *B. alba*, *Salix cinera* and *Arctostaphylos uva-ursi*. Now three of these four species are still natives in the British Islands and all are forms which probably came to us with the Arctic migration which I described. They travelled south with the reindeer and other Mammals, and probably covered tracts of country from which, with the increased struggle for existence later on, they have again been evicted by stronger rivals. But a discovery of their remains does not necessarily indicate that a great change of climate has taken place. Indeed when we carefully examine the present range of Arctic plants in the British Islands, a curious fact presents itself which no doubt has been frequently noted by botanists, viz. that some of the most characteristically Arctic species and some which are often quoted by glacialists in support of their theories of the former presence of an Arctic climate in the British Islands—flourish at the present moment in very mild situations. I need only remind those interested in the history of the Glacial Period that the Mountain Avens (*Dryas octopetala*) abounds in the west of Ireland (Co. Galway), down to sea level. Now it is well known that the mean winter temperature of that part of Ireland resembles that of Southern Europe, being no less than 12° F. above freezing point. Alpine plants when cultivated in Irish gardens seem as a rule to thrive exceedingly well. It would be rash therefore to argue, from the occurrence of Arctic or Alpine species of plants in any deposit, that the locality must have passed through an Arctic climate. Indeed Dr. Thiselton-Dyer has shown that for the most part Alpine plants are intolerant of very low temperature (84, p. 581), and that

at Kew Gardens they are obliged to winter the collection in frames, thus exposing them to a higher temperature than what at present obtains in the British Islands. It seems to me probable, therefore, that the extensive migrations of Alpine and Arctic plants, which undoubtedly took place in past ages, did occur long before the Glacial Period, during a milder and more equable epoch, and that they have since become adapted to live in countries where they receive sufficient moisture during summer and are protected from severe frost in the winter by a cover of snow.

I believe that neither the animals nor the plants which have been discovered in British Pleistocene strata indicate the presence of an Arctic climate in the British Islands during the so-called "Ice Age." The theory of a general glaciation of these islands—the south of England excepted—has, however, been so universally accepted by geologists, that it has almost passed the stage of controversy, and is more generally regarded as an established fact. I am not sure whether even those who are in favour of the view of the marine origin of the boulder-clay, disbelieve in a previous general glaciation. Yet it is not long ago that the generally accepted view was that all the phenomena now attributed to land-ice had been produced by the action of floating icebergs. The rock-scorings, "crag and tail," boulder-clay, scratched stones and drumlins were all believed to be due to the action of the sea assisted by floating ice.

I will not, however, venture to discuss this extremely intricate subject of land ice *versus* floating ice, and hope that geologists may think fit to reconsider their final verdict in the light of the conclusions I arrived at from a study of the geographical distribution of animals.

There is one factor of importance in connexion with this theory of an ice-sheet, which may throw some light on the subject, and that is, the configuration of Ireland during the Glacial Period. Mr. Close remarks (17, p. 241): "Some sufficient increase of relative height towards the west or W. S. W., with a corresponding extension of the land in that direction, is required, if we are to account for the general glaciation of Ireland by the movements of a universal ice-covering formed upon her own surface"; whilst Prof. Bonney seems to think that the coast margin in the earlier part of the Glacial Period may have roughly corresponded with the present hundred-fathom line (10*a* p. 194). The land-connexion between Scandinavia, Scotland, and Ireland formed, as we have seen, a

highway for the migration of the Arctic animals and plants. When the lowlands of Ireland were covered by the sea, which event I presume happened some time during the Glacial Period, a broad belt of land probably remained separating the Atlantic from this westward extension of the Irish Sea.

The boulder-clay which covers such vast tracts of country in the British Islands and the Continent is now generally believed to be the ground moraine of huge glaciers, but I am inclined to think there is equally strong evidence in favour of its marine origin. Shells of Mollusca and Foraminifera are very frequently present, especially in Ireland, and a remarkable number of species have been identified in that country by Messrs. Praeger and Wright (80), though the specimens as a rule occur in a broken condition. When we consider that the clay in which the shells lived has probably been subjected to considerable movements, it is not surprising that they should be in a fragmentary condition and that shore forms should be often found mixed with those inhabiting deeper water.

Before concluding these notes on the Glacial Period, I will give a short sketch of what I think may have been the course of events during that time.

It is probable that before the Glacial Period began, a warm current, not necessarily the Gulf Stream, supplied the Arctic Ocean with warmth. The cessation of this current gave the first impetus to the formation of ice near the North Pole, the Arctic Ocean being then a closed basin. Two extensive transgressions of the Arctic Ocean now took place, one inundating the plains of Arctic America, and the other those of Northern Russia. The latter transgression covered a portion of Northern Continental Europe, and joined the great inland sea, the Ponto-Caspian, by some narrow channels, so that Asia became almost isolated from Europe. The Siberian fauna was, therefore, unable to migrate to Europe, but a number of Asiatic Mammals invaded North America, which was accessible by means of a land-passage across Behring Straits. Meanwhile, Arctic marine species found their way to Northern Germany, and to the western portion of the newly-formed North European Sea, now the German Ocean.

The first occurrence of Arctic forms of life in the newer Tertiary deposits on the east coast of England, marks therefore the period when this marine transgression took place, the German Ocean being, at that time, closed on all sides, except to the east. As Arctic marine species make their first appearance in these English strata in the newer

crags, the latter are synchronous with the lower Continental boulder-clay, in which these same species are first met with. This reasoning might be found fault with, but I have clearly shown (p. 462) that the vast immigration into Europe of Siberian Mammals took place after the deposition of the lower Continental boulder-clay, during the so-called Interglacial phase of the Glacial Period. Now, as the advance guard of this migration reached England during the time when the Forest-bed was laid down, the supposition of the contemporaneousness of the newer crags with the lower Continental boulder-clay seems to me correct. There is no reason to suppose that the interglacial era or Forest-bed Period was characterised by a much milder climate than that preceding it, but, as it was probably much drier, the glaciers which had formed on the Alps and in Scandinavia, receded considerably. The immediate result was a diminution in the amount of detritus carried to the North European Sea by icebergs, so that more extensive colonies of marine animals were able to establish themselves on the sea floor than during the preceding stage of the Glacial Period. The narrow straits, which had formed across the Tchernosjem district in Central Russia, between the Northern Sea and the greatly enlarged Caspian, ceased to exist in the Interglacial phase, owing to the gradual withdrawal of the Arctic waters from Northern Europe. A slight refrigeration of the Siberian climate was the consequence, and the barrier which prevented egress to Europe being now removed, the Northern Asiatic fauna swarmed across the plains of the newly-opened continent.

During all this time, Scandinavia remained connected in the north with Greenland, and in the south and west with Scotland and Ireland, but it had no direct communication with the Continent, being separated from it by the North European Sea. England and France were united throughout the Glacial Period, but the connexion between the former and Ireland broke down during, or shortly after, the deposition of the Forest-bed, so that none of the Siberian migrants, which now poured into England from the Continent, reached Ireland.

Extensive areas of Eastern Yorkshire, according to Prof. James Geikie (35*a*, p. 354), are covered by boulder-clay, with intermediate beds of gravel and sand. Two divisions, viz. a lower and upper clay, are recognizable. The former contains many far-travelled erratics and marine shells, and only a moderate amount of local chalk. But in the purple or upper clay, erratics of home-origin are more conspicuous (p. 364). Prof. Geikie explains these facts in the following manner:—That the basement clay is the direct product of a great

mer de glace, which crept in upon the land from the north-east, and brought the erratics; and that the ice-sheet, which formed over Great Britain, was kept back for a long time by this superior mass, which flowed outwards from the Scandinavian peninsula, but that, as the North Sea ice-flow diminished in bulk, the British ice, which formed the purple clay, was enabled to reach the coast-lands.

It seems to me that the theory of the marine origin of the boulder-clay offers the following simpler explanation. After the Interglacial phase of the Glacial Period had passed away, a renewed transgression of the Arctic waters must have occurred, but the sea did not again invade Central Russia. As Prof. J. Geikie has pointed out (35*a*, p. 463), the erratics included in the upper boulder-clay of Northern Continental Europe have travelled in a different direction from those contained in the lower. A change of current, therefore, evidently took place, owing to the fact that the Northern European Sea was not now connected with the Ponto-Caspian basin.[1]

A large number of erratics would therefore be brought by Scandinavian icebergs stranding on the east coast of England, which was gradually being submerged by the advancing marine transgression. As the water rose, the local glaciers which had begun to form on the mountains of the north of England and Scotland, cast off icebergs which scattered detritus and boulders over the plain.

On p. 366, in speaking of the upper boulder-clay of Holderness, Professor J. Geikie refers to the reappearance of the great *mer de glace* in the North Sea. He infers its presence from the fact that many of the erratics which occur in the clay have been brought down from the high grounds of England to the sea coast, and thereafter have travelled southwards. "Obviously," he says, "the British ice was unable to flow right out to sea; its progress in that direction was barred, and its course determined by the presence of another Scandinavian ice sheet."

An interesting observation which might lead one to a similar conclusion was made by Mr. Kendall, from a study of the erratics in the north of England (96, p 155). It would appear from this, that a portion of the Solway glacier was pushed over the watershed into the valley of the Tyne, that is to say, from the west coast of England to the east coast. "The fate," he says, "of those elements of the Solway glacier which reached the sea is not left entirely to conjecture."

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[1] This again is of great importance in establishing the contemporaneousness of the upper Continental boulder-clay with the whole of the British clays.

"The striated surfaces near the coast of Northumberland indicate a coastwise flow of ice from the northward, probably from the Firth of Forth—and the glaciers coming out from the Tyne and Tees were deflected to the southward."

These facts, read by the light of the marine theory, would imply that there was a current from north to south along the east coast of England. But, as I have repeatedly stated, the north of Scotland stood at a higher level then, and was connected with Scandinavia; and the south of England also was considerably elevated and joined to France. The advancing marine transgression from the east invaded therefore, first the low-lying parts of England, viz. the midland counties, so that a current in that direction was established from all portions of the east coast. Icebergs coming from the Scottish coast would naturally travel along the present coast line to those parts of the lowlands upon which the sea had encroached, and there, perhaps, press up into some of the valleys. Later on, the whole of the lowlands of the midland and northern counties of England were submerged, and the waters of the North Sea joined those of the Irish Sea, and even flooded the plain of Central Ireland.[1] A communication, moreover, was now established between this westward extension, formed by the North European Sea (see map on opposite page) and the Atlantic Ocean, by way of the Severn valley, and the Irish Channel. At the entrance into these two straits, the sea must have risen for a time to a very considerable height, as evidenced by the occurrence of marine shells with sands and gravels, on the Three Rock Mountain in Ireland (1300 feet); on Moël Tryfan, in Wales (1350 feet); and at Macclesfield, in Cheshire (1200 feet). That an iceberg which originated from the Solway glacier should cross the watershed, and flow in an eastward direction and then southward, which would be the explanation of the phenomenon observed by Mr. Kendall, is no doubt curious, but though I think there must have been one main current from the north-east to the south-west, a number of minor ones may have existed round the archipelago of islands which marked the site of Northern England at this period. At any rate the case referred to must be looked upon as

[1] We have an excellent zoological proof of the former direct communication of the Baltic with the Irish Sea, which latter I suppose extended over the plains of Ireland, in the marine relic fauna of some of the Irish lakes. I drew attention (p. 459) to the occurrence of the Arctic marine crustacean *Mysis relicta*, in some of the Swedish lakes, as a proof of the former submergence of the country. This interesting crustacean has not yet been discovered in England, but it occurs again in Lough Neagh in Ireland, thus showing the former continuity of the sea which covered Sweden and that which covered Ireland.

an isolated one. Professor J. Geikie (35 *a*, p. 377) tells us that an ice-sheet traversed North Lancashire and the adjacent parts of Yorkshire and Westmoreland, the general trend of which was towards the south or south-south-east, and that from this might justly be inferred

8.—Map of the British Islands during the latter part of the Glacial Period, showing approximately the ancient land now covered by sea (lightly shaded). The darkly-shaded parts represent the extension of the sea at that time, and the white parts land.

that some barrier existed in the Irish Sea, by which the English ice was prevented from following the slope of the ground, which is towards the south-west.

Here again, I think, the marine theory would explain in a more satisfactory manner than the terrestrial one, the fact of the erratics

being carried in a direction contrary to the natural flow of a glacier, if we remember that probably a strong current existed from the more or less closed North European Sea to the open Atlantic. The occurrence in almost all the English boulder-clays of marine shells tells strongly in favour of the view that these clays are of marine origin. Moreover, they are found to contain Arctic species, and these are mixed with southern forms as we approach the lands adjoining the Atlantic, where an almost purely Mediterranean fauna had hitherto existed. Arctic forms of life now found their way, not only into the Atlantic, but by the newly opened Straits of Gibraltar they entered the Mediterranean, and are preserved to us in some remarkable deposits in Sicily.

We have evidence from the St. Erth beds, to which I have already had occasion to refer (p. 478). that whilst northern forms made their appearance on the east coast of England, the fauna on the west coast remained a purely southern one. This fact induced Messrs. Kendall and Bell (49) to advance the hypothesis that not only were the Straits of Dover closed, but that a land barrier was thrown across the Atlantic from the north of Scotland to Greenland, while the St. Erth beds were laid down.

That the southern marine fauna was once continuous from the west coast of Ireland to the west coast of France, soon becomes apparent to any one who takes the trouble of studying, especially the littoral animals. It is a well known fact that many shore forms which occur along the west coast of Portugal and France reappear again on the south-west coast of England, and on the south and west coast of Ireland: thus clearly indicating the former continuity of range now broken by the English and Irish Channels.[1]

On the Irish side of the Channel, near Wexford, almost opposite St. Erth, there is a deposit in many respects similar to the one just referred to. These Wexford shelly sands and gravels contain, as Mr. Bell (5, p. 623) remarks, "a number of forms of Pliocene Age, and others of a northern type, the relative proportions suggesting that the northern fauna was gradually superseding the decaying southern one." In the low level drift deposits in the Isle of Man, Mr. Kendall has found (48, p. 17), "besides some Boreal forms, many species charac-

[1] The following species may be quoted as examples:—*Strongylocentrotus lividus*, *Achaeus cranchii*, *Inachus leptochirus*, *Gonoplax angulata*, *Thia assidua*, *Aepophilus Bonnairei*, *Blennius galerita*, and *Lepodogaster Decandollii*.

I am indebted to Mr. Nichols for the following additional ones:—*Donax politus* and *Amphidesma castaneum*.

teristic of warmer waters and a notable percentage of extinct species of mollusca." It seems probable, therefore, to judge from these deposits, that, after the St. Erth beds were laid down on the coast of Cornwall, the sea gradually crept up the Irish Channel from the south, and with it the southern fauna; but that shortly after it had taken possession of the Irish Sea, the advent from another direction of a distinctly northern one, checked all further progress of the southern species, and exterminated a number of them. No one, however, has made a more thorough study of the fauna contained in the recent deposits in the north-east of Ireland than Mr. Praeger, and his views on this subject are therefore of value in elucidating the history of the Irish Sea. In the gravels of Ballyrudder, Co. Antrim, which underlie the boulder-clay, he obtained fifteen species of mollusca of a distinctly Arctic character (70*a*, p. 521). In speaking of the boulder-clay of the north-east of Ireland generally, he remarks (70*b*, p. 51): "Somewhat warmer seas existed during the boulder-clay period, inhabited by a fauna still distinctly northern, but containing a few southern forms, along with a diminishing number of Arctic species." "A long period, represented by the Eskers, brick clays, and submerged peat, must have intervened before the depositions of the next bed of the series." "A slight submergence allowed the deposition of the Lower estuarine clay with its rather southern fauna." Then followed a further submergence, during which the southern element attained its maximum, and finally came, according to Mr. Praeger, elevation of land and a distinct return of the fauna towards its northern character.

Mr. Praeger does not offer any explanation of the causes which have produced these very remarkable changes, which he has traced with such skill through the various deposits from the Ballyrudder gravels underneath the boulder-clay to the most recent surface beds.

The distinctly southern element in the Ballyrudder fauna is exceedingly small, amounting only to three per cent. It is very unlikely that it came into the district at the same time as the northern. It is much more probable that it must be looked upon as a mere remnant of an older southern fauna, since it has been shown that such a fauna undoubtedly existed in pre-Glacial times in the Atlantic. According to the conclusions I arrived at from a study of the terrestrial fauna of Ireland, this southern element in the Irish sea was admitted by the breaking down of the southern connexion—the connexion between Wicklow and Wales. When the sea with its Arctic fauna invaded England from the east, and finally joined the Irish Sea, the southern

forms were probably to a great extent exterminated, but, as soon as the eastern current diminished in strength, the southern species would seek to return to their old quarters. Finally, when the old land-connexion between Scotland and Scandinavia broke down, the waters of the North-European Sea found an outlet in that direction, and brought Arctic species directly into the North Atlantic. When at last Scotland and Ireland became separated, a northern fauna would once more supplant the southern one in the Irish Sea. Thus, I think, Mr. Praeger's conclusions as to the changes in the marine fauna of the north-east of Ireland agree in the main points with those which I arrived at from an independent inquiry into the origin of the terrestrial fauna of that island.

From the careful study of terrestrial faunas, indeed, has been gained not only the knowledge of the changes of climate which have passed over the world, but, in the main those geographical revolutions which have been produced in North Europe in recent geological times. To put our knowledge of the origin of the European fauna on a firmer basis has been my object in this memoir, and, although much work still remains to be done in clearing up obscure points in its history, I hope that I have clearly indicated the manner in which future research should be conducted.

I trust also that I have succeeded in strengthening the old Lyéllian theory on the origin of the Glacial Period which has received such strong support from no less an authority than Lord Kelvin (87).

Summary.

p. 427 In this paper I have endeavoured to show how the present fauna of Europe originated. For that purpose it was found advisable to commence the inquiry by the study of the past and present fauna of an island. The British Islands, and in particular Ireland, seemed to me most suitable for that object.

p. 432 to p. 503 The fauna of Ireland as well as the flora is found to consist mainly of two elements, one of which came from the north and the other from the south. In the fauna of Great Britain the same two elements occur, but there is, in addition, a third—an eastern one—chiefly confined to the eastern counties. The southern element contains animals which came originally from South-western, and others which migrated to the British Islands from the South and Central Europe. The former are confined to the south-western counties of England and Ireland, whilst the latter are chiefly found in the south-west of England, Wales,

Ireland, and the west of Scotland. The northern element chiefly occurs in Scotland, the north of England, and the north and west of Ireland.

Though it may be admitted that a small percentage of the British p. 433
fauna reached the British Islands by occasional means of dispersal, the bulk of it migrated on land. A land-connexion must therefore have existed formerly between Great Britain and Ireland, and the Continent of Europe.

The late Edward Forbes believed that the Lusitanian or south- p. 444
western element in the Irish flora (it was not known at the time that there was also a similar fauna) came to Ireland in Miocene times and survived the Glacial Period on a now sunken land which lay to the south-west of that island. Almost all other authorities are convinced that both flora and fauna were entirely exterminated in Ireland during the Pleistocene Epoch, and that what exists there now, migrated to it after the Glacial Period.

A short statement of the general conclusions arrived at with regard p. 444
to the geographical changes in Europe during later Tertiary times, and the chief migrations of animals now follows, so as to facilitate the comprehension of the principal arguments advanced in favour of the view that there were two distinct invasions of northern species, and that the Irish fauna is altogether pre-Glacial.

To judge from the range of the South-western European plants p. 445
and animals in Ireland, it is evident, as Forbes suggested, that they came long before the other southern species or the northern ones. Last of all came the eastern or Siberian migrants. These never reached Ireland, but as we have such abundant evidence of the time of their arrival in Europe, the history of their migration is of great importance, since it furnishes us with a clue to the date of earlier migrations.

We have geological evidence that a vast migration proceeded from p. 445
Siberia, and entered Europe between the Caspian and the Ural Mountains. A large number of Mammals came with this Siberian invasion, and no fewer than twenty-nine species reached England, ten of which still inhabit Great Britain. There is no evidence that any of them ever lived in Ireland.

In the succeeding pages I have endeavoured to ascertain the causes p. 450
of that migration and its geological date. Both Tcherski and Brandt, the two highest authorities, are of opinion that the present Siberian fauna lived in the country already in pre-Glacial times, and that, with the addition of some now extinct forms, such as the Mammoth, it flourished as far north as the New Siberian Islands. Since the advent

of the Glacial Period, the fauna is supposed to have very gradually retreated from these high northern latitudes, which are now almost uninhabitable.

p. 451 Against these views it has been urged that, to some extent, the Mammalian bones and carcases found in the New Siberian Islands, rest on a solid layer of ice, and that as this ice was probably formed during the Glacial Period, the migrations must have taken place in post-Glacial times. This presupposes an extraordinary amelioration of climate in Siberia, the effects of which certainly would have been felt in Europe, but of which we have no evidence.

p. 452 There is geological evidence that a marine transgression took place in Northern Russia in early Pleistocene times, and that at the same time the united waters of the Caspian Sea and the Sea of Aral covered a large tract of the central parts of that country. It is supposed by some naturalists (and in favour of this view I have collected some additional facts) that the White Sea and this large inland sea were connected right across Russia, thus forming a barrier by means of which the Siberian fauna was prevented from migrating to Europe. It is also suggested that the whole of the Continental boulder-clay is a marine deposit, and that its maximum southward extension approximately marks the shores of a North European Ocean.

p. 465 In support of this view are quoted a number of Caspian species which must have come from the Arctic Ocean, and the fact of the occurrence of *Dreyssensia polymorpha*, in the lower and not in the upper Continental boulder-clay, thus proving that a migration took place in both directions.

p. 466 As all the deposits in Continental Europe, containing remains of Siberian Mammals, are of a later age than the lower boulder-clay, it seemed to me that the connexion between the Aralo-Caspian and the White Sea must have ceased to exist during and after the Interglacial phase of the Glacial Period, which would also explain the absence of Dreyssensia in the more recent beds. The Siberian fauna probably began to pour into Europe immediately after the deposition of the lower Continental boulder-clay. But since the first Siberian Mammals made their appearance in England, during the deposition of the Forest-bed, the British newer Pliocene beds must be contemporaneous with this boulder-clay. Further proof of this will be mentioned later on.

p. 468 Some further evidence is now given in favour of the marine origin of the boulder-clay, and the causes of the absence of marine shells in the Russian deposits are explained.

We have geological proofs that the Siberian fauna migrated to Europe on a tract of country, known as the "Tchernosjem" or black earth of Russia, and that this originated from the decay of grass which grew there during long ages. This fauna then invaded Central Europe and Great Britain. In France its further progress was arrested by the River Garonne. England and France must therefore have been connected; whilst the absence of deposits containing Siberian Mammals from Scandinavia proved that it was separated from the Continent. p. 469

The Northern or Arctic element in the Irish fauna must have come directly from the north. It is more or less confined to the northern and western parts of Ireland, and forms a large proportion of the fauna of Scotland and Scandinavia. It suggests that a land-connexion between the latter and the British Islands must have existed. The present and past range of the Arctic hare, the reindeer, and the stoat are discussed in detail to show that such a connexion actually united the two countries. Reference is also made to the North American species occurring in Ireland which belong to the same migration. p. 469

The evidences in favour of a former land-connexion between Scandinavia and Greenland *via* Spitsbergen are now reviewed. p. 479

It is suggested that the American Marine Mollusca which have been discovered in late Tertiary deposits of the east coast of England reached that coast, not from the Atlantic, but from the Arctic Ocean by means of the sea which extended from the White Sea to the German Ocean. p. 479

The migration of terrestrial animals and plants from this ancient northern land southward took place chiefly during the deposition of the newer English crags, and of the Continental lower boulder-clay, that is to say, before the Siberian migrants set foot on British soil. p. 479

The southern migration to the British Islands commenced earlier than either the Arctic or the Siberian. Numerous instances are quoted to prove that the southern fauna is composed of species of south-western and of southern and Central European as well as of Asiatic origin. p. 479

In connexion with the origin of the Red Deer, the nature of the geographical changes which the Mediterranean basin has undergone during later Tertiary times are now discussed. p. 479

In the next pages I have endeavoured to show that Ireland was separated from England at the time while the migration from Southern and Central Europe was in progress. The contradictory evidence from p. 483

fossil sources as to the climate prevailing at that time in the British Islands are there now discussed.

p. 488 The origin and nature of the Glacial Period is so intimately connected with these faunistic problems, that it has been thought advisable to devote a short chapter to this important era in the life of the direct ancestors of our animals. The prevailing opinions as to temperature and general atmospheric conditions during the period are reviewed in connexion with the questions as to the possibility of a survival of the terrestrial fauna and flora chiefly in the British Islands. The British Pleistocene fauna does not indicate the prevalence of Arctic conditions—neither does the flora.

p. 502 This fact certainly supports the view formerly held by geologists that the phenomena in Northern Europe, now attributed to land-ice, have been produced by sea with floating icebergs, under conditions somewhat comparable to those at present obtaining in Tierra del Fuego. A succinct statement of my views on the Glacial Period and the geographical features of Europe at the time—as derived from a study of the European fauna and of its origin—concludes this memoir.

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XIII.

ON THE HOMOGRAPHIC DIVISIONS OF PLANES, SPHERES, AND SPACE, AND ON THE SYSTEMS OF LINES JOINING CORRESPONDING POINTS. By CHARLES JASPER JOLY, M.A., F.T.C.D.

[Read January 11, 1897.]

1. If $OA = \alpha$, $OB = \beta$, and $OC = \gamma$ are three given vectors whose terms A B and C form a triangle; if a, b, and c are three given scalars, and x, y, and z three scalar variables, the vector

$$OP = \varpi = \frac{a\alpha x + b\beta y + c\gamma z}{ax + by + cz}$$

terminates at a point P in the plane of the triangle ABC.

The variables x, y, and z are called by Hamilton the *Anharmonic Coordinates* of P, and he uses the equation

$$(P) = (x, y, z), \quad \text{or} \quad (P) = (xyz),$$

in order to express that P is determined by x, y, and z. (xyz) he calls the *symbol* of P.

The symbols of A, B, and C are

$$(A) = (100), \quad (B) = (010), \quad (C) = (001),$$

and ABC is called the unit-triangle. The point U, whose vector is

$$OU = \upsilon = \frac{a\alpha + b\beta + c\gamma}{a + b + c},$$

and whose symbol is $(U) = (111)$, is called the unit point. The arbitrary scalars a, b, and c are introduced in order that U may occupy an arbitrary position in the plane ABC.

The coordinates are called *anharmonic* because the anharmonics of the pencils $A \cdot BUCP$, $B \cdot CUAP$ and $C \cdot AUBP$ are

$$(A \cdot BUCP) = \frac{y}{z}, \quad B \cdot (CUAP) = \frac{z}{x}, \quad (C \cdot AUBP) = \frac{x}{y}.$$

Since in Hamilton's treatment of these coordinates, the origin is taken in the plane and coinciding with the point U, instead of being arbitrary, it may not be superfluous to remark that, if the lines AU and AP meet BC in U_1 and P_1,

$$(A \cdot BUCP) = (BU_1CP_1) = \frac{BU_1 \cdot CP_1}{U_1C \cdot P_1B}$$

$$= \frac{\dfrac{b\beta + c\gamma}{b + c} - \beta}{\gamma - \dfrac{b\beta + c\gamma}{b + c}} \cdot \frac{\dfrac{b\beta y + c\gamma z}{by + cz} - \gamma}{\beta - \dfrac{b\beta y + c\gamma z}{by + cz}};$$

and this reduces at once to $\dfrac{y}{z}$.

2. The two planes which are swept out by the extremities of the variable vectors

$$OP = \varpi = \frac{a\alpha x + b\beta y + c\gamma z}{ax + by + cz} \text{ and } OP' = \varpi' = \frac{a'\alpha' x + b'\beta' y + c'\gamma' z}{a'x + b'y + c'z}$$

may be said to be anharmonically partitioned or divided.[1] The point P in one has the same anharmonic relations to its unit-point U and to its unit-triangle ABC, as the corresponding point P' in the other has to its unit-point U' and to its unit-triangle $A'B'C'$; or, in general, corresponding points are projective.

3. The system of lines joining corresponding points on the two homographically divided lines

$$OP = \varpi = \frac{a\alpha x + b\beta y}{ax + by} \text{ and } OP' = \varpi' = \frac{a'\alpha' x + b'\beta' y}{a'x + b'y},$$

generate a ruled hyperboloid, the vector expression for which is

$$\rho = \frac{u\varpi + v\varpi'}{u + v} = \frac{s(a\alpha x + b\beta y) + t(a'\alpha' x + b'\beta' y)}{s(ax + by) + t(a'x + b'y)}.$$

Analogy suggests the consideration of the system of lines PP' joining corresponding points *not* on homographically divided lines, but on homographically divided planes.

---

[1] See Clifford's paper on "The General Theory of Anharmonics." Collected works, p. 110.

The vector to a point on one of these lines may be written in the forms

$$\rho = \frac{u\varpi + v\varpi'}{u+v}$$

$$= \frac{s(a\alpha x + b\beta y + c\gamma z) + t(a'\alpha' x + b'\beta' y + c'\gamma' z)}{s(ax + by + cz) + t(a'x + b'y + c'z)}$$

$$= \frac{x(sa\alpha + ta'\alpha') + y(sb\beta + tb'\beta') + z(sc\gamma + tc'\gamma')}{x(sa + ta') + y(sb + tb') + z(sc + tc')}.$$

It is evident that these lines do not generate a surface; they belong to a congruency whose properties will be investigated later on.

4. Some preliminary calculations may be completed by considering the regulus of lines joining corresponding points on homographically divided lines before dealing with the congruency of lines lately referred to; and the results will be useful in pointing out analogies in the more general discussion.

If ϖ and ϖ' are the vectors to any two points on a line, the line is determined by the auxiliary vectors[1]

$$\sigma = \varpi - \varpi' \quad \text{and} \quad \tau = V\varpi\varpi'.$$

In fact $\sigma^{-1}\tau = -\sigma^{-1}V\varpi\sigma = \varpi - \sigma S\varpi\sigma^{-1}$ is the vector perpendicular from the origin on the line, and $\rho = \sigma^{-1}\tau + t\sigma$ is an expression for the vector to any point on the line.

Quoting from Art. 3, the vectors to two corresponding points P and P' on homographically divided lines, are given by

$$xa(\varpi - \alpha) + yb(\varpi - \beta) = 0, \qquad xa'(\varpi' - \alpha') + yb'(\varpi' - \beta') = 0.$$

Operating on both of these by $V(\varpi - \varpi')$, the equivalent forms in σ and τ are found to be

$$xa(\tau + V\alpha\sigma) + yb(\tau + V\beta\sigma) = 0, \quad xa'(\tau + V\alpha'\sigma) + yb'(\tau + V\beta'\sigma) = 0.$$

If $\dfrac{a\alpha + a'\alpha'}{a + a'} = \alpha''$ and $\dfrac{b\beta + b'\beta'}{b + b'} = \beta''$, it is easy to show that

$$S(\alpha - \beta)\tau + S\alpha\beta\sigma = 0, \quad S(\alpha' - \beta')\tau + S\alpha'\beta'\sigma = 0 \quad \text{and}$$
$$S(\alpha'' - \beta'')\tau + S\alpha''\beta''\sigma = 0.$$

[1] The constitutents of these vectors are what Plücker has called the "six coordinates" of the line.

From these

$$-\tau S(\alpha-\beta)(\alpha'-\beta')(\alpha''-\beta'') = V(\alpha'-\beta')(\alpha''-\beta'')S\alpha\beta\sigma$$
$$+ V(\alpha''-\beta'')(\alpha-\beta)S\alpha'\beta'\sigma + V(\alpha-\beta)(\alpha'-\beta')S\alpha''\beta''\sigma.$$

Thus τ is given as a linear vector function of σ or $\tau = \phi\sigma$ suppose, and the condition $S\tau\sigma = 0$, constrains σ to be parallel to an edge of the cone $S\rho\phi\rho = 0$.

5. When P and P' are corresponding points on homographically divided planes,

$$xa(\varpi-\alpha) + yb(\varpi-\beta) + zc(\varpi-\gamma) = 0,$$

and

$$xa'(\varpi'-\alpha') + yb'(\varpi'-\beta') + zc'(\varpi'-\gamma') = 0,$$

lead as in the last article to the equivalent forms

$$xa(\tau + V\alpha\sigma) + yb(\tau + V\beta\sigma) + zc(\tau + V\gamma\sigma) = 0,$$

and

$$xa'(\tau + V\alpha'\sigma) + yb'(\tau + V\beta'\sigma) + zc'(\tau + V\gamma'\sigma) = 0.$$

From the second of these,

$$\begin{aligned} &x : y : z \\ &= b'c'V(\tau + V\beta'\sigma)(\tau + V\gamma'\sigma) : c'a'V(\tau + V\gamma'\sigma)(\tau + V\alpha'\sigma) \\ &\qquad : a'b'V(\tau + V\alpha'\sigma)(\tau + V\beta'\sigma). \end{aligned}$$

But

$$\begin{aligned} V(\tau + V\beta'\sigma)(\tau + V\gamma'\sigma) &= -V\tau V(\beta'-\gamma)\sigma + V.V\beta'\sigma V\gamma'\sigma \\ &= -\sigma(S\tau(\beta'-\gamma') + S\beta'\gamma'\sigma); \end{aligned}$$

so the set of ratios is equivalent to the simpler set

$$\begin{aligned} &x : y : z \\ &= b'c'(S\tau(\beta'-\gamma') + S\beta'\gamma'\sigma) : c'a'(S\tau(\gamma'-\alpha') + S\gamma'\alpha'\sigma) \\ &\qquad : a'b'(S\tau(\alpha'+\beta') - S\alpha'\beta'\sigma). \end{aligned}$$

Substituting in the first equation,

$$ab'c'(\tau + V\alpha\sigma)(S\tau(\beta'-\gamma') + S\beta'\gamma'\sigma) + bc'a'(\tau + V\beta\sigma)(S\tau(\gamma'-\alpha') + S\gamma'\alpha'\sigma)$$
$$+ ca'b'(\tau + V\gamma\sigma)(S\tau(\alpha'-\beta') + S\alpha'\beta'\sigma) = 0.$$

Again, if the ratios $x : y : z$ had been found from the first and substituted in the second equation, the result would have been

$$a'bc(\tau + V\alpha'\sigma)(S\tau(\beta-\gamma) + S\beta\gamma\sigma) + b'ca(\tau + V\beta'\sigma)(S\tau(\gamma-\alpha) + S\gamma\alpha\sigma)$$
$$+ c'ab(\tau + V\gamma'\sigma)(S\tau(\alpha-\beta) + S\alpha\beta\sigma) = 0.$$

These equations, though apparently different, will now be shown to be equivalent, and either of them may be taken as the equation of the congruency of lines joining corresponding points of the homographically divided planes.

6. If ρ and ρ' are any two points on a line of the congruency, and if $\sigma = \rho' - \rho$, then will $\tau = V\rho'\rho = V\sigma\rho$.

The first equation of the congruency now takes the form,

$$\frac{a}{a'}V\sigma(\rho-\alpha)S\sigma(\rho-\beta')(\rho-\gamma') + \frac{b}{b'}V\sigma(\rho-\beta)S\sigma(\rho-\gamma')(\rho-\alpha')$$
$$+\frac{c}{c'}V\sigma(\rho-\gamma)S\sigma(\rho-\alpha')(\rho-\beta') = 0,$$

as may be verified by elementary transformations.

If

$$\begin{aligned}\phi\sigma\, S(\rho-\alpha')(\rho-\beta')(\rho-\gamma') = {}&\frac{a}{a'}(\rho-\alpha)S\sigma(\rho-\beta')(\rho-\gamma')\\ &+\frac{b}{b'}(\rho-\beta)S\sigma(\rho-\gamma')(\rho-\alpha')\\ &+\frac{c}{c'}(\rho-\gamma)S\sigma(\rho-\alpha')(\rho-\beta')\end{aligned}$$

defines a linear vector function ϕ, the first equation of the congruency may be written in the simple form

$$V\sigma\phi\sigma = 0.$$

Now $\phi(\rho-\alpha') = \frac{a}{a'}(\rho-\alpha)$, $\phi(\rho-\beta') = \frac{b}{b'}(\rho-\beta)$, $\phi(\rho-\gamma') = \frac{c}{c'}(\rho-\gamma)$;

whence it is not difficult to verify that the inverse function ϕ^{-1} is defined by

$$\begin{aligned}\phi^{-1}\sigma\, S(\rho-\alpha)(\rho-\beta)(\rho-\gamma) = {}&\frac{a'}{a}(\rho-\alpha')S\sigma(\rho-\beta)(\rho-\gamma)\\ &+\frac{b'}{b}(\rho-\beta')S\sigma(\rho-\gamma)(\rho-\alpha)\\ &+\frac{c'}{c}(\rho-\gamma')S\sigma(\rho-\alpha)(\rho-\beta)\end{aligned}$$

and, accordingly, that the second equation of the congruency may be reduced to the form

$$V\sigma\phi^{-1}\sigma = 0.$$

This new form is of course equivalent to $V\sigma\phi\sigma = 0$, since either expresses that σ is parallel to an axis of ϕ—a linear vector function varying with ρ.

7. The order of the congruency is now determined to be three. For, as ρ is the vector to an arbitrary point, and as σ $(=\rho'-\rho)$ is parallel to a line of the congruency through that point, the three axes of ϕ are parallel to the lines through the assumed point.

8. In order to determine the class of the congruency, or the number of lines which lie in an assumed plane $S\lambda\rho = 1$, it is only necessary to express that two corresponding points P and P' lie in the plane. Referring to the first equations of Art. 5, if $S\lambda\varpi = 1$ and $S\lambda\varpi' = 1$, then

$$xa(S\lambda\alpha - 1) + yb(S\lambda\beta - 1) + zc(S\lambda\gamma - 1) = 0,$$

and $$xa'(S\lambda\alpha' - 1) + yb'(S\lambda\beta' - 1) + zc'(S\lambda\gamma' - 1) = 0.$$

Taking the vector expression for the line PP' in terms of x, y, and z, which is given in Art. 3, the equation of the *single* line of the congruency which lies in the plane is found on elimination of x, y, and z to be given by the determinant,

$$\begin{vmatrix} sa(\rho-\alpha)+ta'(\rho-\alpha') & sb(\rho-\beta)+tb'(\rho-\beta') & sc(\rho-\gamma)+tc'(\rho-\gamma') \\ a(S\lambda\alpha-1) & b(S\lambda\beta-1) & c(S\lambda\gamma-1) \\ a'(S\lambda\alpha'-1) & b'(S\lambda\beta'-1) & c'(S\lambda\gamma'-1) \end{vmatrix} = 0.$$

As this is the equation of a single definite line, the class of the congruency is unity.

Of course when the plane is not arbitrary, more than one line may lie in it. For instance, if the plane is one of the divided planes, so that $S\lambda\alpha = S\lambda\beta = S\lambda\gamma = 1$, the determinant vanishes identically, and no longer determines a definite line. Indeed, this plane contains an infinite number of lines joining points in it to the corresponding points on the other plane which lie on their common intersection.

9. By the general relations connecting the order and class of a congruency with those of its focal surface, the focal surface of the congruency under discussion is seen to be a developable of the fourth degree. This appears also on consideration of the reciprocal congruency which is of the first order and the third class, and whose lines are, therefore, chords of a twisted cubic.[1]

The equation of the focal surface may, however, be obtained without difficulty. It is necessary to calculate, in the first instance, the

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[1] Salmon, "Three Dimensions," Art. 457.

invariants of the function ϕ of Art. 6. Remembering that $\phi(\rho - \alpha') = \frac{a}{a'}(\rho - \alpha)$, &c., the invariants are

$$m_1 = \frac{\Sigma S(\rho-\beta')(\rho-\gamma')\phi(\rho-\alpha')}{S(\rho-\alpha')(\rho-\beta')(\rho-\gamma')} = \frac{\Sigma \frac{a}{a'} S(\rho-\alpha)(\rho-\beta')(\rho-\gamma')}{S(\rho-\alpha')(\rho-\beta')(\rho-\gamma')}$$

$$m_2 = \frac{\Sigma S(\rho-\alpha')\phi(\rho-\beta')\phi(\rho-\gamma')}{S(\rho-\alpha')(\rho-\beta')(\rho-\gamma')} = \frac{\Sigma \frac{bc}{b'c'} S(\rho-\alpha')(\rho-\beta)(\rho-\gamma)}{S(\rho-\alpha')(\rho-\beta')(\rho-\gamma')}$$

and

$$m_3 = \frac{S\phi(\rho-\alpha')\phi(\rho-\beta')\phi(\rho-\gamma')}{S(\rho-\alpha')(\rho-\beta')(\rho-\gamma')} = \frac{\frac{abc}{a'b'c'} S(\rho-\alpha)(\rho-\beta)(\rho-\gamma)}{S(\rho-\alpha')(\rho-\beta')(\rho-\gamma')},$$

where $g^3 - m_1 g^2 + m_2 g - m_3 = 0$ is the cubic determining the roots of ϕ.

10. On reduction this cubic takes the form

$$\begin{aligned} & abc\,[S\rho V(\beta\gamma + \gamma\alpha + \alpha\beta) - S\alpha\beta\gamma] \\ & - g\,[S\rho\Sigma a'bc V(\beta\gamma + \gamma\alpha' + \alpha'\beta) - \Sigma a'bc S\alpha'\beta\gamma] \\ & + g^2[S\rho\Sigma ab'c' V(\beta'\gamma' + \gamma'\alpha + \alpha\beta') - \Sigma ab'c' S\alpha\beta'\gamma'] \\ & - g^3 a'b'c'\,[S\rho V(\beta'\gamma' + \gamma'\alpha' + \alpha'\beta') - S\alpha'\beta'\gamma'] = 0. \end{aligned}$$

This, being linear in ρ, may be regarded as the equation of a plane involving a variable parameter g rationally in the third degree.

Now, if two roots of the cubic of a linear vector function are equal, two of the axes of the function will in general coincide.[1] So then, if the discriminant of the cubic here written is equated to zero, it will determine by its vanishing those points ρ through which pass two coincident lines of the congruency. In other words, the developable enveloped by the variable plane is the focal surface of the congruency.

11. Again, regarding s and t as constant in the equation of a line of the congruency given in Art. 3, it is obvious that the plane determined by varying x, y, and z is homographically divided with the two given planes. Eliminating x, y, and z, the result

$$S[as(\rho-\alpha) + a't(\rho-\alpha')][bs(\rho-\beta) + b't(\rho-\beta')][cs(\rho-\gamma) + c't(\rho-\gamma')] = 0,$$

involves the ratio $s : t$ in the third degree, and agrees with the

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[1] *Transactions, R.I.A.*, vol. xxx., p. 600.

equation of the plane found in the last article to envelope the focal surface. This corresponds to a property of the hyperboloid—viz., its double generation. If in its equation, as given in Art. 3, s and t are supposed to be constant, the equation is to be interpreted as that of a generator of the second system, and the locus of these second generators is of course the hyperboloid.

Through a given point three of these planes pass, and it is easy to see, as in Art. 8, that each of them contains an infinite number of lines of the congruency.[1] It would appear from this that their three lines of intersection are the lines of the congruency which pass through the given point.

12. Just as a plane was divided anharmonically, space may be divided anharmonically. Take a pyramid, $ABCD$, and let the vectors to its vertices be α, β, γ, and δ respectively. The vector

$$OP = \varpi = \frac{xa\alpha + yb\beta + zc\gamma + wd\delta}{xa + yb + zc + wd}$$

is capable of representing any point in space. The plane through C, D, and P meets the edge AB in the point $\dfrac{xa\alpha + yb\beta}{xa + yb}$. The plane through the unit point U, which is represented by the vector

$$OU = v = \frac{a\alpha + b\beta + c\gamma + d\delta}{a + b + c + d},$$

and the edge CD meets AB in $\dfrac{a\alpha + b\beta}{a + b}$. The anharmonic of the pencil of planes joining AB to C, U, D, and P, is equal to $\dfrac{z}{w}$; or $(AB \cdot CUDP) = \dfrac{z}{w}$. Similar results hold for planes through the remaining edges.

Now, if two different unit pyramids are taken and two arbitrary unit points, the lines joining P and P', corresponding points in the anharmonic divisions, belong to a complex.

Suppose

$$OP' = \varpi' = \frac{xa'\alpha' + yb'\beta' + zc'\gamma' + wd'\delta'}{xa' + yb' + zc' + wd'},$$

[1] These lines envelop a conic since, reciprocally, the chords of a twisted cubic which pass through a fixed point on it lie on a quadric cone.

then using the auxiliary vectors σ and τ, which have been defined in the 4th Article,

$$xa(\tau + Va\sigma) + yb(\tau + V\beta\sigma) + zc(\tau + V\gamma\sigma) + wd(\tau + V\delta\sigma) = 0,$$

and $$xa'(\tau + Va'\sigma) + yb'(\tau + V\beta'\sigma) + zc'(\tau + V\gamma'\sigma) + wd'(\tau + V\delta'\sigma) = 0.$$

Operating on these by $S\lambda$ and $S\mu$, and eliminating x, y, z, and w, the determinant of the fourth order

$$\begin{vmatrix} a\,S\lambda(\tau + Va\sigma) & b\,S\lambda(\tau + V\beta\sigma) & c\,S\lambda(\tau + V\gamma\sigma) & d\,S\lambda(\tau + V\delta\sigma) \\ a\,S\mu(\tau + Va\sigma) & b\,S\mu(\tau + V\beta\sigma) & c\,S\mu(\tau + V\gamma\sigma) & d\,S\mu(\tau + V\delta\sigma) \\ a'S\lambda(\tau + Va'\sigma) & b'S\lambda(\tau + V\beta'\sigma) & c'S\lambda(\tau + V\gamma'\sigma) & d'S\lambda(\tau + V\delta'\sigma) \\ a'S\mu(\tau + Va'\sigma) & b'S\mu(\tau + V\beta'\sigma) & c'S\mu(\tau + V\gamma'\sigma) & d'S\mu(\tau + V\delta'\sigma) \end{vmatrix} = 0$$

is the resultant.

13. Expanding this by minors from the first and second rows, since

$$S\lambda\,(\tau + Va\sigma)\,S\mu\,(\tau + V\beta\sigma) - S\lambda\,(\tau + Va\sigma)\,S\mu\,(\tau + V\beta\sigma)$$
$$= SV\lambda\mu\,V(\tau + Va\sigma)V(\tau + V\beta\sigma) = -S\lambda\mu\sigma\,(S\tau\,(a - \beta) + S\sigma a\beta)$$

by Art. 5, it is evident that the factor $(S\lambda\mu\sigma)^2$ is extraneous. This being discarded, the result is

$$\begin{aligned} & bca'd'\,(S\tau\,(\beta - \gamma) + S\sigma\beta\gamma)\,(S\tau(a' - \delta') + S\sigma a'\delta') \\ + & cab'd'\,(S\tau\,(\gamma - a) + S\sigma\gamma a)\,(S\tau(\beta' - \delta') + S\sigma\beta'\delta') \\ + & abc'd'\,(S\tau\,(a - \beta) + S\sigma a\beta)\,(S\tau(\gamma' - \delta') + S\sigma\gamma'\delta') \\ + & b'c'ad\,(S\tau\,(\beta' - \gamma') + S\sigma\beta'\gamma')\,(S\tau(a - \delta) + S\sigma a\delta) \\ + & c'a'bd\,(S\tau\,(\gamma' - a') + S\sigma\gamma'a')\,(S\tau(\beta - \delta) + S\sigma\beta\delta) \\ + & a'b'cd\,(S\tau\,(a' - \beta') + S\sigma a'\beta')\,(S\tau(\gamma - \delta) + S\sigma\gamma\delta) = 0. \end{aligned}$$

The form of this equation shows that the complex is of the second order and of the second class, for σ and τ both enter in the second degree. As in Art. 6, putting $\tau = V\sigma\rho$, the equation in σ which results, is that of a quadric cone containing the lines which pass through ρ. If $S\lambda\rho = 1$ and $S\mu\rho = 1$ determine a line of the complex, it is easy to see that $\sigma = V\lambda\mu$ and $\tau = \lambda - \mu$; so if λ is given and μ variable the result of substituting these values in the equation of the complex is a quadratic in μ, and represents therefore a curve of the second class in the arbitrary plane $S\lambda\rho = 1$. This curve is the conic enveloped by the lines in that plane.

14. If α, β, γ, and δ are unit vectors, the equation

$$\rho = U(xa\alpha + yb\beta + zc\gamma)$$

is that of a sphere anharmonically divided. The unit triangle is ABC and the unit point is $\delta = U(a\alpha + b\beta + c\gamma)$. The sphere may be considered to be divided by the projection on it from its centre of any one of the planes

$$\rho = \frac{xa\alpha + yb\beta + zc\gamma}{xl + ym + zn},$$

where l, m, and n are arbitrary. If however $l = m = n = 1$, the unit point on the plane is the mean point of the unit triangle in it. So in order to divide a sphere anharmonically with respect to a given unit triangle (α, β, γ) and a given unit point (δ), it is only necessary to resolve δ along α, β, and γ, to draw a plane through the points thus determined on these lines, and to construct in this plane a net having for unit triangle the points on these lines and for unit point the mean point of the triangle.

15. The quaternary coordinates[1] for a plane, x, y, z, and w, where

$$\rho = \frac{xa\alpha + yb\beta + zc\gamma + wd\delta}{xa' + yb' + zc' + wd'},$$

and $$0 = a\alpha + b\beta + c\gamma + d\delta,$$

and $$0 = a' + b' + c' + d',$$

may also be used for a sphere. The vectors being still unit,

$$\rho = U(xa\alpha + yb\beta + zc\gamma + wd\delta),$$

with the condition

$$a\alpha + b\beta + c\gamma + d\delta = 0,$$

is a symmetrical form which expresses that the sphere is anharmonically divided with respect to the four points represented by α, β, γ, and δ, or by the symbols

(1000), (0100), (0010), and (0001).

[1] A particular case of the Quinary coordinates for space. See "Elements of Quaternions," Art. 70.

The homographic plane

$$\rho = \frac{xa\alpha + yb\beta + zc\gamma + wd\delta}{x + y + z - 3w}$$

is divided with reference to the three points represented by $a\alpha$, $b\beta$, and $c\gamma$, and their mean point $-\frac{1}{3}d\delta$.

As regards the "equation of congruence" ("Elements," Art. 71), it is sufficient to remark that $(xyzw)$ and $(tx+s,\ ty+s,\ tz+s,\ tw+s)$ represent the same point on the surface of the sphere if t is positive, but opposite points if t is negative. The symbol (1111) denotes no definite point because the versor of a null vector is wholly arbitrary.

16. As Hamilton does not seem to have given the types of points of "Third construction" for a plane net, it may be useful to give them here. The points of first construction derived from the four points $P_0 = (1000)$ are $P_1 = (1100)$ and the lines constructing them are $\Lambda_1 = [1, -1, 0, 0]$. The lines of second construction are $\Lambda_2 = [1, -1, 1, -1]$ and the points are $P_2 = (1, -1, 0, 0)$.

These points P_2 lie by threes on $\Lambda_{3,1} = [111-3]$ and connect with P_0 by $\Lambda_{3,2} = [011-2]$. The intersections of $\Lambda_{3,1}$ and Λ_1 determine the type $P_{3,1} = (3100)$; those of $\Lambda_{3,2}$ and Λ_1, the type $P_{3,2} = (2100)$; $\Lambda_{3,2}$ and Λ_2 give $P_{3,3} = (3210)$; $\Lambda_{3,1}$ and $\Lambda_{3,2}$ give $P_{3,4} = (-3, 2, 1, 0)$, and the lines $\Lambda_{3,2}$ mutually intersect in $P_{3,5} = (4210)$ in addition to the old points.

XIV.

HUMAN LOCOMOTION: VARIATION OF VELOCITY WHEN WALKING. By RALPH CUSACK.

(Plate VI.)

(Communicated by G. Fitzgerald, D.Sc., F.T.C.D.)

(Read April 26, 1897.)

One remarkable provision of nature often overlooked is the ease and smoothness with which man walks, especially when it is considered that the impulse forward is received only about once in the second. Dr. Joly first called my attention to these facts and pointed out that when a man was seen walking across a Venetian blind, which shut off his up and down motion, his walk appeared to be very uniform. Observe a boy walking on stilts, his motion always appears jerky, his legs are kept quite stiff, and the elasticity of the muscles of his legs and feet cannot come into play, which they do when he is walking naturally along the ground.

The following experiments will show to some extent the degree of uniformity with which an ordinary man walks and how the uniformity varies with circumstances in the same individual:—

The greatest difficulty in obtaining the variation of velocity of a man walking is to record the velocity without the individual being conscious of it. If the individual knows that he is walking for a certain purpose, the velocities recorded are not that of the unconscious mechanical walk, but that of the voluntary. Thus the question arises, in what way do these two walks differ, if they differ at all? That they differ, and that the mechanical walk is more uniform than the voluntary appears obvious, inasmuch as all our mechanical movements are more regular than our voluntary movements. As an example, when the number of respirations of an individual are being measured, so long as the person's attention is distracted from the apparatus, the record of his breathing is uniform, but if his attention is called to the fact that his respirations are being recorded, the

breathing becomes irregular. Also when asleep the respirations are very regular. It is therefore to be expected that the mechanical walk, that is, the walk when the thoughts of the walker are distracted from the action of his walking, will be more uniform than the walk of which the walker is conscious.

The apparatus first devised for recording the velocity at short intervals of a man walking was as follows:—A drum such as is used for recording the vibrations of a tuning-fork was procured; such a drum is usually driven by a small motor, but in the present case to the driving axle I attached a boxwood cylinder about two inches in diameter, removing the ordinary driving wheel. On this cylinder was wound about 30 yards of light, non-elastic string. Ordinary white tea-twine answered the purpose very well. The end of this string was attached to a light belt round the walker's waist, and when the walker walked away from the apparatus he unwound the string from the cylinder, thus driving the drum. Round the drum was attached the ordinary smoked paper, and on this a tuning-fork recorded its vibrations. The tuning-fork used gave nineteen vibrations per second. Now the velocity at which the drum was driven varied, according to the rate at which the string was unwound, that is to say, the velocity at which the man walked. If the velocity of the man was uniform during each step the length of the waves recorded on the drum would all be equal. This I found was not the case, but the change in velocity was so small that the variation in the length of the waves could only be perceived with difficulty. The above apparatus was found unsuitable, inasmuch as the drum jerked when the motion was irregular, also the motion of the drum was difficult to control.

The following modification was made and was found more convenient, as the recording apparatus could be placed in a room away from where the man was walking, communication being made by wires and an electric current.

The boxwood cylinder was replaced by the original driving pulley, and the drum was driven by an electric motor.

The motion of the drum was now quite uniform, and its velocity easily controlled. The tuning-fork vibrations on the drum now merely sound to mark time, and were of course quite regular. To record the velocity of the walker the following instrument was made. A boxwood cylinder about 6 inches long and 3 inches in diameter was turned on a steel mandrel, which mandrel afterwards served as the axle. To one end of the cylinder was attached a commutator, with

ten divisions, so that ten contacts were made with the brush every revolution of the cylinder. The intervals of these makes and breaks were equal. This cylinder rotated between two screws with conical points, and by varying the pressure on the coned surfaces, as was required, the effects of the inertia of the cylinder could be easily got rid of. A brush in contact with the commutator made the electrical connections as the cylinder revolved.

Round the cylinder a string was wound which was attached to the walker, and was unwound by him when walking away from the apparatus. An electro-magnet, in circuit with the commutator, recorded the velocity of the cylinder by attracting a soft iron armature controlled by a spring. When the circuit was closed the armature, or rather a lever projecting from the armature, was so arranged that it made a stroke on the smoked paper. When the current was open the armature being pulled back by the spring, a blank was left. This little instrument worked rather like a Morse instrument, and the recording was also similar to that of a Morse instrument, as may be seen in the diagram (fig. 2, p. 532). If now a man walked uniformly the number of strokes between each wave-length would be equal.

By the use of this apparatus the velocity could be obtained during a single step about 40 times, if the length of the strokes were measured. This I found difficult and unnecessay, and it was sufficient to take the velocity at the end of each wave-length, and plot it to obtain the curves. This was done by simply counting the number of strokes in each wave-length and plotting this number to scale. From the beginning of one scratch to the beginning of the next is counted as one "stroke."

The steps of the walker were recorded on the drum by another electro-magnet in circuit with the instrument shown in figure 1.

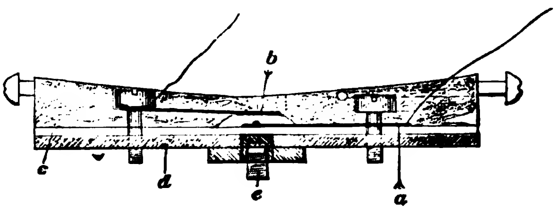

FIG. 1.

This instrument was fastened by straps under the instep up against the heel of the boot and consisted of a piece of fibre cut so as to fit the curved part of the boot under the instep and next the heel. To

this was attached a brass plate which held a movable button; this button could be regulated so as to project beyond the heel any desired amount, according as the walker's heel was high or low. When the heel came to the ground this button was pressed up and made contact with a platinum point, thus closing the circuit through the electro-magnet. When the heel was again lifted the button was returned to its original place by means of a spring. The wires were brought up the outer side of the leg in a rubber tube to the middle of the back, where a twin wire was attached and drawn after the man as he walked. The twin wire was very light, and was practically no impediment to the walker.

Some experiments were made to ascertain if two points similarly situated on each foot ever rested on the ground at the same time when one is walking. For this purpose two strips of tin-foil about four yards long and a foot wide, were laid on the ground, a quarter of an inch apart, side by side. To the sole of each boot was fastened a little button, the size of a brass pin's head; these buttons were connected by a wire brought up the legs, and could be attached to any part of the sole. Now the strips were so arranged that when the walker stood still, one foot on each strip, he closed a circuit through an electro-magnet, which made a mark on the drum. By shifting the buttons I found that no two similarly situated parts of the foot were ever on the ground at the same time. Though the toes of one foot and heel of the other were on the ground together for less than $\frac{1}{30}$ of a step, if the man was walking slowly, but for a shorter time if the walking was fast.

An experiment was also made to show that the flexibility of the sole of the foot greatly helped the pedestrian. When a heavy pair of shooting boots with nails were used by the walker his motion was much more irregular than when he had light flexible boots on his feet. This I found to be the case with every individual I tried.

The three curves shown (Plate VI.) are perhaps the best examples I obtained of typical walks. The curve A shows the variation in velocity of the most uniform walker I experimented on, and curious to say, seeing him walking, one would imagine that his motion would be very irregular. Curve C is the most non-uniform velocity recorded, yet the amount of variation was always the same, and a curve obtained for the variation of one step of the right foot would be similar to that obtained for every other, though that of the right foot-step and that of the left footstep never were quite the same. It was found that no matter how non-uniform the walking was that the curves

went on repeating over and over again. I plotted curves for many yards of walking and found this to be always the case.

The third curve B may be taken as representing the average variation of velocity, and I here give some of the ordinates by which the curve was obtained. From these can be clearly seen the way in which the vibrations for the steps repeat themselves. The length of the ordinates are given in tenths of an inch, and are obtained by counting the number of "strokes" in each wave-length. As mentioned previously a "stroke" is taken to be the distance from the beginning of one dot to the beginning of the next. Each "stroke" is given on the curve the value of one-tenth of an inch, and a wave-length the one-half of an inch. The velocity is plotted vertically and the time horizontally in the Plate. Half an inch represents the one-nineteenth of a second. The fourth curve on the Plate shows variations from mean.

It will be observed that the walker whose velocity is here recorded walked more uniformly with his right foot than with his left. This fact is even more marked in other cases than in the particular case here mentioned.

Ordinates in tenths of an inch.		Difference of Or.
0·00	. . . .	—
6·00	. . . .	6·00
12·00	left heel comes to ground .	6·00
18·00	. . . .	6·00
23·00	. . . .	5·00
27·50	. . . .	4·50
31·50	. . . .	4·00
35·25	. . . .	3·75
40·25	. . . .	5·00
46·25	. . . .	6·00
52·00	right heel comes to ground .	5·75
57·75	. . . .	5·75
62·75	. . . .	5·00
67·25	. . . .	4·50

Ordinates in tenths of an inch.		Difference of Or.
71·50	. . . .	4·25
76·50	. . . .	5·00
81·25	. . . .	4·75
87·25	left comes to ground .	6·00
93·25		6·00
99·25		6·00
104·25	. . . .	5·00
108·75	. . . .	4·50
112·75	. . . .	4·00
117·75	. . . .	5·00
122·75	. . . .	5·00
128·50	. . . .	5·75
134·50	right comes to ground . .	6·00
140·00		5·50
145·00	. . . .	5·00
149·50	. . . .	4·50

Now the left heel was put on the ground between 6·00 and 12·00, so here the left step begins. The right step begins at about 52·00.

I have substracted the ordinates, so that it can be clearly seen how they repeat themselves for each alternate step. Between 31·50 and 35·25 it will be noticed that the velocity was lower than it ought to have been; this presumably was due to the walker having slipped, or more likely to a fault in the apparatus, such as a slight jerk. I noticed that the same thing happened in several cases, and it is more likely due to the apparatus than to the walker. It will also be seen that the variation for the two feet is not the same. By glancing at the curves it will be seen that the velocity is at a maximum shortly after the heel is placed on the ground, and diminishes then until the other heel has nearly reached the ground. The velocity decreases more rapidly than it increases, especially in the case of the curve B, where it will be seen that velocity increases very slowly almost from the time the heel of one foot is removed from the ground until the heel of the other foot is about half-way over its course—there the velocity is at a maximum. It then suddenly falls off for about two-ninths of a step, the heel being raised from the ground about half through this period of decrease, that is to say, about one-ninth of a step from the time when the velocity has a maximum. Thus it will be seen that in the case of the curve B the velocity was increasing during seven-ninths of a step and diminishing during two-ninths. It will be seen that in both the other curves shown, the time of increase is only slightly greater than that of decrease.

The velocity, as will be seen from the curves, varies very uniformly, the least variation obtained was 12·5 per cent. from the mean, while the greatest variation was over 26 per cent. from the mean. These were extreme cases, and out of 27 individuals whose velocity was recorded 23 varied from 16 to 18 per cent.

The following are the variations from the mean of each individual whose walk was recorded:—

12·5	16·2	17·9
14·7	16·3	17·9
15·2	16·6	18·0
15·8	16·7	18·0
16·0	17·2	18·1
16·0	17·6	18·7
16·1	17·6	19·9
16·1	17·7	22·6
16·1	17·9	26·2

All of these individuals had 8 and some 12 records taken of their

walks, each of which was nearly similar to the previous one, the difference in no case amounting to more than one or two per cent. *when they were walking under similar circumstances.* But if a walker had on heavy boots or even a heavy overcoat, his velocity was greatly altered, and in some cases this alteration amounted to nearly 30 per cent. This latter, in cases where walkers were provided with heavy fishing-boots. An overcoat or other light weight on the back altered the velocity in no case to a greater extent than 5 per cent. No heavy weight on the back was tried.

It will be seen that on an average when a man is walking under ordinary circumstances his velocity varies only about 17 per cent. from the mean. That is, he will be walking about one-third faster for some portion of his step than another. It must be remembered that this is the case when men are walking under circumstances that can hardly be called natural, for their brains are certainly to some extent occupied by the idea that they are walking for an experiment. Nowt here is reason to believe that men would and do walk more uniformly when walking, suppose, in the street in conversation with a friend, than they would in the experiments here recorded.

The method here employed is perhaps somewhat better than that in use by Marey, which is mentioned

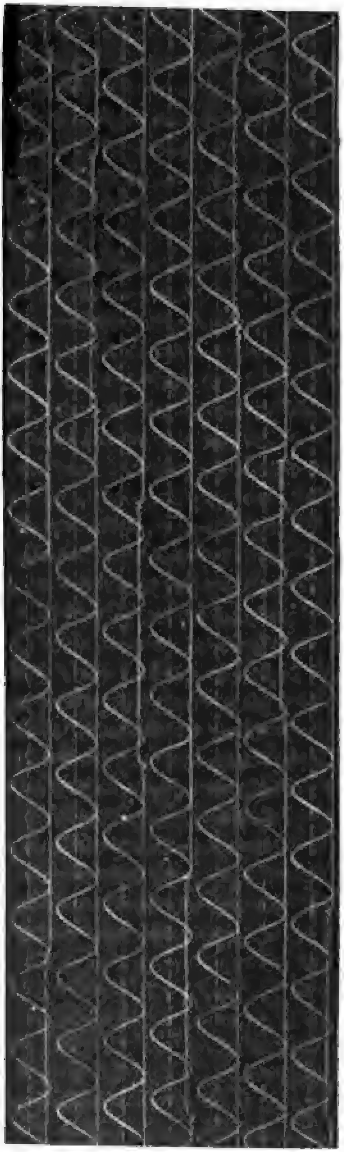

Fig. 2.

by him in the "Machine Animale" in a chapter entitled the "Marche de l'Homme."

Marey had a man walking round in a circle 6 metres in diameter, and pushing a beam in front of him. Now it will be seen that when a man walks round a circle his inside foot will not have so much ground to cover as his outside foot, and also that he will have to turn through a considerable angle at each step. A man would walk round this circle in about 25 steps, so he would be really walking a polygon with 25 sides and would thus have to turn through an angle of 14° each step. These facts I think would account for the fact that Marey appears to get much greater variations than were got in my experiments, though indeed from the very meagre account given, it would be difficult to say accurately what results he got. But one great difference easily perceived is that he gets the velocity greatest at the commencement of each step, and gradually diminishing until the end of the step, whereas from these experiments it would appear as if the velocity only reached its maximum a short time after the step is commenced, and reaches a minimum before the step is half completed.

A reproduction of a paper off the chromograph is shown (fig. 2, p. 532). The wavy line is that marked by the tuning-fork, each of the waves representing the nineteenth of a second. The little strokes are made by the electric magnet in circuit with the commutator of the cylinder, which if the individual walked uniformly would be equal in length, and each wave would have the same number of strokes in it. The other line with an occasional "shake" in it, is that made by the pedometer. When the line after a "shake" is higher than before the "shake"—during the time the line is higher, the heel of the foot to which the pedometer was attached was on the ground (in the present case the left foot);—when the heel was raised, there is another "shake," and the line returns to its old position, the left heel being off the ground. These papers were dipped into a weak solution of shellac to preserve the smoking on them, which otherwise might be rubbed off.

XV.

THE EFFECT OF CHANGE IN TEMPERATURE ON PHOSPHORESCENT SUBSTANCES. By R. S. CUSACK.

(Plate VII.)

[COMMUNICATED BY GEO. F. FITZ GERALD, D.SC.]

[Read April 26, 1897.]

Chemical compounds that possess the property of storing up light-energy when exposed to certain ethereal vibrations are generally known as phosphorescent substances. Such phosphorescence must not be confused with phosphorescence in the animal kingdom, which is due to combustion.

Of the many minerals that possess the property of, as it were, bottling up light, one of the most remarkable is fluorspar; it was while making experiments on crystals of fluorspar with the object of expelling the light from the crystal without cracking the latter that the quantity of light-energy which it was possible for a phosphorescent substance to store up seemed to me to depend on the temperature at which the substance was exposed to the source of light. And also that the amount of light that it was possible for a body to hold was dependent on the temperature.

Before entering into these latter experiments I have to give an account of the experiments which led to them, and which were made with the object of ascertaining if possible whether fluorspar or any other phosphorescent substance increased in volume when "charged" with light-energy. It was at the suggestion of Dr. Joly that I first started the investigation, as he thought it possible that a substance, when it had stored up light-energy, would increase in volume. The difficulties to be overcome were numerous, but especially that arising from change in temperature, and as was afterwards found the heat of the finger at a distance of nearly ten centimetres produced considerable effect on the apparatus. The apparatus first devised was a flat glass bottle with a capillary tube ground into the stopper. Into this bottle the broken up fragments of a fluorspar crystal were put, and the

bottle was then filled with water. Now when the stopper was put in, the water rose in the capillary tube to a certain height. The bottle and its contents were then illuminated by the light from the spark caused by the rapid discharging of a Leyden jar connected with the terminals of an induction coil. If the water rose in the capillary tube, as I found it did, either something must have expanded, or the bottle contracted; the expansion, however, was observed whether a phosphorescent substance was in the bottle or not, and I subsequently found that the expansion was due solely to heat. This apparatus was therefore abandoned, and the following, "Newton's Ring" apparatus, adopted instead:—

This instrument consists of three brass pillars parallel to each other, secured into a heavy metal base. On each of these pillars is cut a screw of forty threads to the inch, reaching over the upper six inches of the pillars which are eight inches high. A flat ring of brass, with three holes cut in it for the pillars to pass through, is supported by nuts which run on the screws; this ring can thus be placed at any height on the pillars that is necessary. A convex mirror and a lens suitable for producing interference rings by reflection are contained in a circular brass box, which box fits into the centre of the ring. The whole lens apparatus can thus be raised or lowered as is necessary without disturbing the lens; also dust is not so liable to get between the lens and mirror. The lens is stationary, being cemented to the case, and the mirror is supported on the top of a screw, by means of which it can be adjusted so as to get the rings in a suitable position. Through this screw passes a steel rod, on the upper end of which the mirror when adjusted rests, the lower end resting on the crystal, or other substance under observation. The whole apparatus is then surrounded by a cardboard cylinder, and by adjusting a slit in this cylinder a beam of light can be arranged so as to strike the substance under observation only. The light used was that from the spark of a Leyden jar as previously mentioned. When a crystal of fluorspar was taken, and as much as possible of the light it contained driven out without cracking the crystal, it was adjusted, sitting on the bed-plate and having the steel rod resting on the upper edge of a face; the whole length, therefore, of one face of the crystal was between the bed-plate and the rod which supported the mirror. The apparatus, when adjusted, was so delicate that the heat of the fingers when adjusting expanded the supports, which were allowed to cool before an experiment was attempted. Sodium light was used to illuminate the rings, and when the cross wires of the

telescope used for reading was adjusted, a movement of the eighth of a wave-length of sodium light could be easily read. Now with a pillar of fluorspar over three inehcs long no movement of the ring was observed; that is to say, the crystal did not expand the one four hundred and fifty thousandth of its length. I also tried pillars of calcium sulphide without any result.

It was while making the foregoing experiments that I observed that a piece of fluorspar when heated for a second time gave out light, though when the first heating had ceased no light was being given out.

It was found when the matter was looked into that at the second heating the temperature was higher than it had been in the first. The following are accounts of the experiments made:—

A crystal of fluorspar was broken up into pieces about the size of a nut; some of these pieces were taken and heated in a sand bath for four hours, the temperature being kept as nearly as possible at 300° C. The spar glowed for about four hours, after which time the glow ceased. The crucible was then allowed to cool till next day. Now when these pieces of spar were heated again they did *not* glow till the temperature was raised above the temperature of 300° C.; to which they had been raised when first heated. The glow off the spar when heated for the second time was easily observed, though rather faint. When the spar was heated for the second time it was raised to about 500° C., and glowed for nearly an hour. These temperatures were obtained by observing when certain minerals, whose melting points were known, fused. The temperature could be kept fairly constant, as the experiments were conducted in a room without draughts, heat being supplied by a Bunsen burner with the flame kept to a certain height, also a large quantity of sand was used in the crucible. By making further experiments at other temperatures I found that fluorspar always contained some light until it was heated to a temperature of about 500° C.; at which temperature all the light was expelled. Fluorspar raised to this temperature, allowed to cool, and again heated, omitted no light, no matter to what temperature it was subsequently raised.

It was found that fluorspar might be kept at any temperature up to about 500° C. for a long time without losing all its light. In fact I kept some pieces of spar for two days at about 300° C., yet these pieces glowed when afterwards raised in temperature.

I now exposed some fluorspars at 300° C. to the sparks from a Leyden jar coupled with the poles of an induction coil, and found that

at 300° C. the spar did not phosphoresce as brilliantly as at normal, and that when heated to about 500° C. it did not phosphoresce at all.

Fluorspar was abandoned at this point as it was found difficult to deal with, inasmuch as when powdered it would not phosphoresce as well as when in pieces, and the pieces were difficult to handle. Instead I tried, along with other salts, a calcium sulphide which phosphoresces violet, and with which it was much easier to work.

Before leaving the subject of the fluorspar, I may say that several specimens of artificial fluorspar which I succeeded in making in the dark did not phosphoresce when the temperature was raised. A gelatinous precipitate of fluorspar was obtained in the dark. This precipitate was then taken and boiled in water for many hours, until it had assumed a partially crystalline form; it was then carefully dried, and, when dry, heated to about 300° C. No phosphorescence was observed. The above operations were all carried on in the dark, but even when carried on, as they subsequently were in full daylight, no glow was observed when the calcium fluoride was heated.

To see whether the artificial calcium fluoride would phosphoresce at all, I exposed some of it to the Leyden jar spark, and found that it phosphoresced with considerable brilliancy, though not nearly so brilliantly as the natural fluoride. The operation of precipitating the fluoride was then carried on in the light of the Leyden jar sparks, and the digesting of the gelatinous fluoride thus obtained was carried on in the dark. The calcium fluoride obtained thus did not glow when the temperature was raised. It must be remembered, however, that the gelatinous compound might not retain light when raised to the boiling point of water; certainly the gelatinous fluoride phosphoresces when exposed to the sparks at ordinary temperature, but the glow dies more rapidly than in the case of the crystalline, neither is it brilliant.

The whole operation for obtaining the semi-crystalline calcium fluoride was now carried out under the Leyden jar sparks, or rather I should say as much as possible of it, for the induction coil could not conveniently be kept working all the time the gelatinous precipatate was being digested, and was only worked at intervals. The fluoride thus obtained phosphoresced as would be expected when the temperature was raised. Now although these experiments tend to show that fluorspar has to be exposed to light before it phosphoresces, it would be very surprising to find that a piece of spar taken from the bottom of a mine where it could never have been exposed to light failed to phosphoresce when heated. This is an experiment I hope

before long to have the opportunity of carrying out, and I am quite prepared to find that the fluorspar does phosphoresce when heated. It is possible, of course, that the crystallization may be the cause; suppose that, when crystallizing, the fluorspar gave out light which it bottled up for itself as it gave it out. Certainly fluorspar absorbs light comparatively slowly when exposed to sunlight, but especially when exposed under glass. I have never succeeded in getting fluorspar to *glow* when exposed under glass to the sunlight, unless heated, nor indeed to the sun with no glass interposed, though I have been told it does.

Phosphorescing sulphides are, as has been previously said, easier to deal with than fluorspar, and they store up light-energy in just the same way. Accordingly all the curves of brightness shown are for different sulphides.

The principal difficulty experienced in obtaining these curves was to obtain a suitable photometer, none of the ordinary arrangements being found convenient. The instrument I used is made out of a cigar box, and has up to this been found satisfactory. The lid of the cigar box was removed, and a piece of stout cardboard made to fit in its place. In this cardboard a round hole, 1 cm. in diameter, was cut, and underneath the hole is fixed a little 8-volt lamp. When this lamp is in circuit with the storage cells the light shines through the hole in the cardboard. On this hole, to diminish the intensity of the light that is emitted by the lamp, little sheets of paper cut to a suitable size are laid and pressed together by a glass weight. All the sheets are cut from the same sheet of tracing-paper and are very uniform in thickness and colour. A slip of coloured glass can be interposed between the hole and the slips of paper when necessary, so that the difference in colour of the substance under observation and the light emitted by the lamp may not increase the difficulties of comparing the two intensities. To get a numerical measure of the intensity we may assume roughly that as the number of sheets of paper interposed increase in arithmetical progression the light that comes through decreases by geometrical progression.

If the fraction of light that comes through one paper be P, then the light that comes through n papers is, roughly, P^n;

$$\therefore \quad I = I_0 P^n,$$

$$\log \frac{I}{I_0} = n \log P.$$

Now when it is only required to compare the brilliancy of bodies

when phosphorescing at different temperatures, recollecting that P is less than unity so that $\log P$ is negative;

$$\therefore \quad I \propto, \text{ Antilog } n.$$

When it is required to find the actual amount of light emitted by a body it is necessary to find either the value of I_0 or P, I_0 being the intensity of the light emitted by the lamp through the 1 cm. hole when no paper is interposed.

For an example let us suppose that at + 15° C. the light of the photometer lamp had to be redueed by putting on seven papers until the maximum brightness of the phosphorescing substance was equal to it. By always starting work from normal, the lamp can easily be got the same brightness by comparing it with the brightness of the substance phosphorescing at 15° C.

To find a measure of the relative brightness of a substance phosphorescing at + 15° and + 100°; if at + 100° 13 papers had to be interposed in addition to the 7 at + 15° before the brightness was reduced to the brightness of the phosphorescing body, it is necessary to find the antilog of 7 and 20, and the reciprocals of these antilogs will be a measure of the relative brightness of + 15° and + 100° respectively. These may of course be plotted to any convenient scale.

With regard to the manner in which the bodies under observation were heated and cooled, I may observe that CO_2 alone and in conjunction with sulphuric ether were the only cooling agents used; with these the temperatures of − 40° and − 80° were obtained. The temperatures between normal and + 100° were obtained by immersing the body contained in a nickel basin about one inch and a quarter deep and an inch wide at the top, in heated water. A thermometer dipped into the water, and when the brightness of the photometer was, by trial, got equal to that of the body phosphorescing its maximum, the thermometer was read. A large volume of water was used and the vessel was surrounded with several layers of felt, so the temperature kept fairly constant; but at all events the error arising from misreading in temperature would only have been trifling when compared with those due to the photometer reading.

Considerable difficulty arose in getting a suitable means of raising the temperature above 100°. Mercury was at first tried, but the vapour got over everything, and besides being injurious to breathe was injurious to the instruments. Glycerine was also tried without success, as also were several other organic compounds. Finally fusible

alloys were tried and were found very suitable; an alloy consisting of 3 parts of bismuth, 3 parts of lead, and 1 part of tin was used. This latter alloy was melted in a nickel vessel; in this a smaller nickel vessel containing the substance for observation was immersed and covered up with a piece of cardboard in which there was a hole the same size as that in the photometer. Through this hole the light from the sparks fell on the substance and the light emitted by the latter reaches the eye. A thermometer is also immersed in the melted alloy. To read this thermometer in the dark a small glow lamp is so arranged as to throw a beam of light along the stem, and can be moved so as to illuminate any part of the column of mercury that may be necessary.

When a phosphorescing substance has been heated and cooled ever so often, so long as it has not been decomposed, the maximum intensity of the light emitted at the same temperature is the same, although the time which the substance takes to reach its maximum brightness may vary somewhat; only two exceptions to this have as yet been observed, and it is doubtful whether these are true exceptions or not, inasmuch as the physical structure of the substance may have altered.

The fluorides of barium and strontium, after being heated for the first time to a temperature of about 700° C., phosphoresce more brilliantly than before being heated. But if they are heated again ever so often, they do not appear to phosphoresce more brilliantly than they did after the first heating. Of many other substances examined the only difference observed after being heated was that they reached their maximum brightness sooner than they did before they were heated. The difference in time was however only a second or two. I have failed to observe any difference in the structure of the barium or strontium fluorides under a microscope before and after heating; but if we suppose that the crystals increase in size when heated, it is obvious that the substance would phosphoresce more brilliantly when the crystals were larger. As the crystals were very minute, not distinguishable under the microscope, it is quite possible for them to increase in size without the increase being observed, as the crystals are massed together very closely.

On Plate VII. are shown six curves, three of which were plotted from the calculated antilogs, and three others, which have broader lines were plotted from these antilog curves, and are reciprocal to them. These latter three give some idea of the manner in which the intensity of the light from the phosphorescing substances vary. It will be seen that a specimen of strontium sulphide (c) has ceased to phosphoresce

before the calcium sulphide (A) had reached its maximum; also that calcium sulphide seems to have a larger range of temperature over which it phosphoresces than strontium sulphide. The specimen of barium sulphide (B) has not reached its maximum at – 80°, when the other two substances have greatly diminished in brightness.

The following are the results of experiments from which the curves (A) for calcium sulphide were plotted:—

	No. of Papers.	No. ÷ 15.	Antilog of No. ÷ 15
+ 283°	13·0	·8$\dot{6}$	73·6
230°	9·0	·60	39·8
194°	6·8	·45$\dot{3}$	28·4
139°	6·3	·42	26·4
96°	7·0	·4$\dot{6}$	29·3
49°	7·5	·50	1·6
+ 16°	8·0	·53	34·0
– 40°	10·0	·$\dot{6}\dot{6}$	46·4
– 80°	11·3	·75$\dot{3}$	56·7

The number of papers was divided by 15 to make the curve plottable, and the antilogs there given have been multiplied by 10 for the same reason. From the antilogs given here a curve was plotted, and from this curve once obtained, the reciprocal curve was afterwards plotted; this was done in the case of each substance.

The great difficulty in making observations is working the photometer, and on account of the errors arising from this source these curves are only approximate. I have tested them in several ways. Thus when a curve is drawn, by making an observation and seeing if it agrees with the curve, we have an excellent test, and I have found the observation falls usually a trifle too low. A difference of one paper interposed makes a very considerable difference in the plotted curve, and it is very hard to judge to less than one paper.

With reference to the curves, A is that for calcium sulphide; B for barium sulphide, and C for strontium sulphide; the corresponding small letters indicate the antilog curves from which the intensity curves were plotted.

XVI.

THE DISTRIBUTION OF "CROMLECHS" IN THE COUNTY OF CLARE. By THOMAS JOHNSON WESTROPP, M.A.

(Plates VIII., IX., and X.)

[Read May 24, 1897.]

The great group of Cromlechs[1] in the county of Clare lies (with the exception of scarcely half a dozen examples) within an extensive district, 40 miles long by 10 wide, running in a south-easterly direction, from the sea coast to the eastern border. The Cromlechs are not only numerous in the hills (as might be expected), but also in the level country of Magh Adhair, probably the longest cultivated and inhabited plain in the county. Some 115 exist or are known to have recently existed.

The oldest traditions preserve no record of any territorial division corresponding to this long strip of country. When the Dalcassians burst into the present county of Clare[2] in the last half of the fourth century, they are said to have found the lands occupied by various Firbolgic tributaries of the kings of Connaught.

First, the people of Tradraighe or Tradree, who held a nearly square district in the angle formed by the Fergus and Shannon, bounded to the north and east by the "Gissagh" (Rine), which flows past the friary of Quin, and the "Owen na Cearnaigh," which washes the walls of Bunratty Castle. This, as first subdued, seems to have formed the mensal land of the princes of Thomond, down, perhaps, to Donchad Cairbrech O'Brien, after whose death in 1242 it was held at intervals by English grantees, De Musegros and the three De Clares. Its mensal character may explain the strenuous endeavours of Brian Boru to recover it from the Danes; also its grant to De Musegros

[1] I use this variant and controverted term to cover all the varities of primitive stone structures confused under that title on our maps, and under the term Labba Diarmada by the peasantry.

[2] Not known as "Thomond" till after their conquest. The older "Thomond" was probably eastern Limerick and northern Tipperary.

by the English Government, and that by King Brian Roe O'Brien to Thomas de Clare in 1276. Its importance is farther marked by the enormous triple stone forts at Moghane and Langough.[1]

Secondly, the inhabitants of Magh Adhair, once extending from the Fergus nearly to Tulla, possessing the great forts of Cahercalla and Cahershaughnessy, the mound of Inauguration, and some 30 cromlechs.

Thirdly, an ill-defined district, extending along the eastern and northern borders, including Slieve Bernagh, Slieve Aughty, the parish of Inchicronan, and the greater part of the baronies of Inchiquin and Islands; of its earlier occupants nothing certain is known, only vague legends about the Tuatha De Danaan. Most of it was held by the Dalcassians (the Hybloid, Hycaisin and Kinel Fermaic), when its history commences. On its Galway border lay Lughid (Ath na Luchaid) the farthest limit of the Dalcassian Kingdom, and doubtless the site of some disastrous battle, as suggested by the curious "prohibition" laid on the King of Connaught: "In a speckled cloak let him not go to the Heath of Luchaid in Dal Chais.[2]" It contains some 20 cromlechs.

Fourthly, the mountainous tract of the Corcomroes, said to have been held by the Firbolgs of Irgus, Dael, and Ennach,[3] but was possessed in historic times by the offshoots of Clan Rory—the O'Conors and O'Loughlins. It contains some 40 cromlechs and several hundred stone forts, including the great cahers of Ballykinvarga and Cahercommane.

Lastly, the angle formed by the sea and the Shannon, Corcovaskin, first held by the Martini (a large Firbolg tribe, who also appear round Emly in the ninth century), and then by the race of Cairbre bhascaoin, whence its later name was derived. It only possesses one cromlech, that of Kiltumper.

Most of the existing structures are small box-like cists tapering and often sloping towards the east, the cairns and mounds in which at any rate many were embedded being now nearly removed. A few long graves of several chambers occur at intervals over all the district, and a few small "demi dolmens" round Tulla. An interesting type of stone enclosure is found at Clooney and Dooneen, north of Quin.

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[1] See Journal Royal Society of Antiquaries of Ireland, 1893, p. 281; 1896, p. 146.

[2] "Book of Rights," p. 21.

[3] Dindseanchas ("Revue Celtique," 1894, p. 479).

Two lists have already been published by Miss Stokes. The first in "Early Christian Architecture of Ireland" (1878), p. 146. Cragballyconnell (Burren, No. 11); Coolamore (Burren, No. 3); Knockalassa (Inchiquin, No. 19); Kiltumper (Clonderlaw, No. 1); Bally cum marga (Corcomroe, No. 3); Caher mac crusheen (Corcomroe, No. 1); Kilnaboy; Commons North (Inchiquin, No. 4); Knocknaglaise (perhaps No. 1); Teeshagh (ditto, No. 3), and Shallee. In this list the last was a cairn, and no cromlech has existed at Kilnaboy since at any rate 1839.

The second is in "Revue Archéologique," 1882, pp. 19–21. Inchiquin, Shallee, Inaghbridge, Kilfenora (Baile cinn marga), Kilnabow (Ballyganner, Burren 27, Reabacan, Giant's Grave, Coteen, Know na glaise, Leaba na glaise), Oughtmama. There are actually none at Inchiquin, Inaghbridge, Kilnaboy, and Oughtmama. Leaba na glaise is the "Teeshagh" of list No. 1. Neither list names one out of over sixty examples east of the Fergus.

I cannot hope that my own list will prove complete, for many more cromlechs doubtless exist in cairns, in lonely thickets and among almost impassable crags; but, as it is founded on local examination, undertaken in some instances for the Ordnance Survey (and thus also in return gaining much information from that body), I hope to record accurately the main lines of distribution and the principal groups. I only describe a few good examples of the leading types of these monuments.

1. Ballyganner (sheet 9, Ordnance Survey, 6 inches to 1 mile). These townlands contain an interesting group of remains, lying about three miles N. W. of Kilfenora on a deserted craggy plateau. Starting from the hamlet of Noughaval, which possesses a venerable church, parts of which are as old as the tenth century, we pass the fine stone fort of Cahercuttine, with an interesting gateway and stairs, commanding a glimpse of Liscannor bay and castle through a gap in the hills; close beside it lie two broken dolmens, a cairn, and one of those puzzling structures like a miniature caher, 24 feet in diameter, enclosing a small souterrain. Four other stone "forts" lie along the ridge in line. Turning eastward from Cahernaspekee,[1] we meet two more, one enclosing a slab hut, and finally reach the objects of our search.

The first consists of three compartments, but the "eastern" is nearly defaced. Its "southern" side lies N. N. E. and S. S.W.; the "western" room measures 8 feet × 6 feet, its entrance is flanked by pillars 5 feet

[1] It is also in line with the great forts of Ballykinvarga and Doon. This linear arrangement also occurs in Scotland (Proc. Soc. Ant. Scotland, 1890–91, p. 203).

high, the roof slabs have split and fallen, but when perfect the pillars overtopped them by at least a foot. The central chamber is 5 feet 6 in. long by 6 feet, and has similar pillars to its northern door; they are 6 feet high, and rose 2 feet above the roof, forming a trilithon, of which the lintel has fallen. There was an outer facing of slabs, the spaces between these and the sides having been packed with small stones and clay. (Plate X., fig. 1).

Eastward lies the fort Caheraneden with a "fosleac" or slab hut, whence a straight road, made by removing the top layers of the crags, runs south to the second, a fallen cromlech, the north and top slabs are each about 9 feet 8 by 6 feet 8. A third stands inside a nameless caher with its west end embedded in the rampart; it tapers from 7 feet at the west to 4 feet east, and consists of three side slabs, the southern 13 feet 8 inches long; the top has been broken into five fragments, probably by fire. A fourth (very perfect) stands in the wreckage of a cairn. It is a small cist of four stones, the east end being open. The south side lies W. N. W. and E. S. E.; the N. and S. sides measure respectively 11 feet 5 inches and 12 feet 7 inches, while the top slab is 13 feet long and 7 feet 8 inches broad, it has two channels in its upper surface, probably waterworn. A fifth, of exceptional size, crowns the hill (above Ballyganner castle in its surrounding caher) and forms a very conspicuous landmark, its top slab has numerous little basins a few inches across, possibly like the "marmites du diable" in the dolmens of Brittany, once used for offerings of butter, &c., to the spirits residing in the cist, and the "elf mills" described by Dr. Montelius as occurring in the top slabs of Swedish cists. The south side measures 18 feet 6 inches long by 7 feet 8 inches; its north is 17 feet 4 inches long; it tapers eastward from 9 feet 7 inches to 6 feet 2 inches. The top slab when perfect must have measured 11 feet by 20 feet.

ADDROON[1] (sheet 18 in Moyree Commons).—A singular monument of five stones, apparently a chamber, 6 feet 6 inches by 5 feet, with parallel sides, lying east and west. (Plate IX., fig. 4). Within it two large blocks are set (the western askew), dividing it into two cells, the north-west triangular, the eastern of a lozenge shape, about 6 feet by 3 feet. The northern "insertion" is 9 feet 8 inches high,

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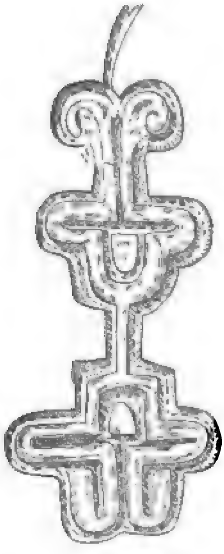
[1] Addroon, Corbehagh, Tyredagh, and Caherloghan cromlechs are not marked on the six-inch Ordnance Survey. Mr. Borlase's "Dolmens of Ireland" contains a view of Knockeen dolmen, county of Waterford (p. 61). Addroon, when perfect, must have closely resembled this monument.

the other only 3 feet; the sides are most unequal in height, being, north, 6 feet 4 inches; south, 5 feet; and east 13 inches. A large slab is so balanced on the south side that its inner end presses upwards against the north "insertion."

Corbehagh (sheet 19), on the hills near Dromandoora. I notice it to correct the very inaccurate sketch of a curious rock-carving near it,[1] which appeared in our *Proceedings.* This is cut on a naturally-polished surface of the native rock, and is a curious arrangement of two frets, the lower ends curved, the upper forming spirals, the outer edge cut straight into the rock, and the bands slightly rounded. A cross and "I.H.S." have been rudely cut below it in recent years. South from this, on the native rock near the brow of the hill, the outline of a foot has been incised; it points southward.



The lower cromlech is very perfect; a chamber 8 feet 2 inches wide, tapering eastward from 6 feet 5 inches to 3 feet 3 inches; the sides project 3 feet farther east, where they are 1 foot 8 inches apart. It is formed of 7 blocks of purple conglomerate (2 each in the sides and the west end, and one to the east), and a top slab, sloping eastward, 11 feet long, and from 8 feet 2 inches to 2 feet 2 inches wide. These remains will be marked on the new survey maps, as I called the attention of Captain Sloggett, R.E., to their existence.

Clooney (sheet 34).—Two "giant's graves" in the demesne of Mr. Hall. The eastern had two, if not three rings greatly defaced, the largest block being 12 feet 6 inches by 8 feet by 2 feet. The western consists of an oblong enclosure (30 feet N. and S., 11 feet E. and W.), its longer sides lying N.N.W. and E.S.E., and the angles cut off. It is formed by double rows of slabs, the interspace packed with field stones; it stands on a low mound near a stream. (Plate X., fig. 2.)

Tyredagh (sheet 27).—A "long cromlech" of five compartments. Its north side lies N.N.E. and S.S.W. It tapers from 7 feet 6 inches to 6 feet 6 inches in 20 feet. It lies in a little valley bounded on the east by low cliffs. The western end overhangs a small stream; both

[1] Proc. R.I.A., vol. x., p. 441.

ends and the roof slabs have fallen. It was probably covered with earth.[1] In Tyredagh demesne a large cromlech of the usual type stands in the farmyard, a small earth ring in the garden, and a pillar stone 9 feet by 5 feet near the gate; they are preserved by the Gore family.

CAHERLOGHAN (sheet 34).—A group of three small "demi-dolmens" near Moymore Bridge. Each consists of a slab, its east end supported by another stone. The top slabs measure respectively 6 feet by 6 feet 8 inches by 12 inches, 7 feet 3 inches by 4 feet 2 inches by 18 inches, and 2 feet 3 inches by 4 feet by 12 inches.[2] The side of another cist is preserved in a modern wall. A fifth, consisting of a ruined cairn and cist, stands in a grove of bushes west of the large "demi dolmen"; while the top slab of a large dolmen remains in the southern fields of the townland. It has been set up on edge by the farmer who removed the other stones.

BASIN STONES.—A few examples of these interesting objects occur near prehistoric sepulchres in the county of Clare. (1) Near Cappaghkennedy cromlech lies a small limestone slab, 18 inches by 12 inches, in which appears five little cups, about 2 inches in diameter. Three are complete, and ground smooth; two have been commenced, and picked with some pointed instrument. (2) Near the mound of Magh Adhair, one already described in our *Proceedings*.[3] (Plate IX., fig. 3.) (3) A round basin, 12 inches in diameter, in a block of yellow sandstone lying in a grove in Kiltanon demesne, near the only remaining block of a large cromlech, at which unbaptized children were buried till about forty years ago. (Plate IX., fig. 2.) (4) A round basin (10 inches diameter) in the east end block of the cromlech in Newgrove demesne. (Plate IX., fig. 1.)

LIST OF "CROMLECHS" IN THE COUNTY OF CLARE.

(*Arranged under baronies, and numbered as on* Plate VIII.)

BURREN.—Ballycahill, 5. Ballyganner North, 23, 24, 25. Ballyganner South, 26, 27. Ballymihil, 9. Ballyvaughan, 1. Berneens,

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[1] Since the date of this Paper, Mr. Borlase has published my plan of the Tyredagh dolmen ("Dolmens of Ireland," vol. i., pp. 87, 88). He has, I think, made a slight error in concluding that the sides of the west "giant's grave," at Clooney, "meet in a point" to the north (p. 82). The north, like the south end, was nearly straight and is in perfect preservation.

[2] In the Dindsenchas ("Revue Celtique," 1894, p. 286), mention is made of a small grave of two stones, $3' \times 3\frac{1}{2}'$.

[3] Proc. R.I.A., Series III., vol. iv., p. 56.

6, 7, 8 (three in line: the first is possibly in the adjoining townland of Ballyallaban). Cappaghkennedy, 17 (with basin stone). Carran, 29 (cist in a cairn near the church; funerals still go round it). Cooleamore, 3, 4. Craghballyconoal, 11, 12. Deerpark of Lemeneagh, 28. Fanygalvan, 18, 19, 20 (three in line). Faunarooeca, 2. Moheramoylan, 16. Noughaval, 21, 22. Poulaphuca, 10. Poulnabrone, 14, 15 (there is said to have been a second, but I am very doubtful). Rannagh East, 13. Total, 28 or 29.

Corcomroe.—Ballykinvarga, 3. Cahermaccrusheen, 1. Caherminane, 2 (the "Kiltennan" or "Ballykinvarga," in the *Burren* list of Mr. Borlase. Cloneen, 4 (near border of Ballyganner South). Total, 4.

Inchiquin.—Addroon, 17 (in Moyree Commons). Ballycasheen, 14 (a "long cromlech," the "Ballykissheen" of Hely Dutton's list. Commons North, 4, 5 (the "Cotteen" of Dutton). Dromore, 18 (others are said vaguely to exist in the thickets). Gortlecka (or Ashfield), 15, 16. Knockalassa, 19 (a very regular cist on Mount Callan). Leanna, 6, 7, 8 (probably the "Reabachan" of Dutton, if he does not mean Parknabinnia). Parknabinnia, 9, 10, 11, 12, 13 (three not marked on 1839 survey). Slievenaglasha, 3 (near Teeskagh, probably "Tullyglashin" of Dutton). Tullycommane, 1, 2. Total, 18 or 19.

Islands.—Carnelly, 1 (a very doubtful example; it has undergone a rebuilding).

Clonderlaw.—Killtumper, or Tumper's grave, 1.

Bunratty Upper.—Ballyhickey (at Hazelwood), 9. Ballymacloon, 18. Ballymaconna (at Kilraghtis), 3. Ballyogan, 4. Caheraphuca, 1. Caherloghan, 12 to 17 (a group of four small semi-dolmens, included in Moymore in my former list, followed by Mr. Borlase, is in this townland). Clooney, 10 & 11. Dooneen, 7 (same type as No. 10). Kilvoydan, 2. Knappogue, 19. Moananoe, 8. Rylane, 5, 6 (5 is a "long cromlech"). Total, 19.

Bunratty Lower.—Ballinphunta (at Croaghane Church), 5. Ballysheenbeg, 4. Brickhill, 6. Dromullan, 2 (two remain). Kilcornan, 1 (has a large incised cross on top slab). Knockalappa, 3. Total, 7.

Tulla Upper.—Altoir Ultach, 19. Cappabaun, 23. Corbehagh or Dromandoora, 21, 22 (near rock markings). Corracloon, 20. Kiltanon, 12 (with basin stone). Maryfort, or Lismehane, 17. Miltown, or Ballymullen, 4 to 11 (five destroyed between 1840 and 1892). Moymore, 13 to 16. Newgrove or Ballyslattery, 3 (with basin stone). Roslara, 18. Tyredagh Upper, 1 (long cromlech). Tyredagh Lower, 2, Tobergrania, near Altoirultach (now a holy well). Total, 23.

TULLA LOWER.—Ardnataggle, 13 ("long cromlech"). Ardskeagh, 5. Ballykelly (above Kilseily church), 10. Bealkelly Purdon, 2. Cloghoolia, 11. Cloonyconrymore, 6, 7 (6 is a "long cromlech"). Drummin, 4. Elmhill, 1. Formoylemore, 8. Killokennedy, 3. Knockshanvo (or Knockaphunta), 9. Lackareaghmore, 12. Total, 13. A large "table stone" is said to exist near the river in the fields south of O'Callaghan's mills.

NOTE ADDED IN PRESS.

Mr. W. Borlase, in "Dolmens of Ireland," vol. i., pp. 65–102, gives illustrations and plans of the following in the county of Clare :—

BURREN.—Berneens, Ballyganner South, Ballykinvarga (Caherminane), Deerpark Cappaghkennedy.

CORCOMROE.—Cloneen.

INCHIQUIN.—Tullycommane, Slievenaglasha, Leana (two), Commons North, Parknabinnia, Ballycasheen, Knockalassa.

BUNRATTY UPPER.—Caheraphuca, Caherloghan, Rylane (two), Knopogue.

BUNRATTY LOWER.—Ballinphunta.

TULLA UPPER.—Tyredagh Upper and Lower, Newgrove, Miltown, Moymore (three *recte* Caherloghan, on whose border they lie), Rosslara, Maryfort, Dromandoora.

TULLA LOWER.—Ballykelly, Formoylemore, Cloonyconrymore.

Mr. Borlase, in his list of dolmens, records for—

BURREN, . . .	23	BUNRATTY LOWER .	7
CORCOMROE, . .	2	TULLA UPPER, . .	21
INCHIQUIN, . .	7	,, LOWER, . .	12
BUNRATTY UPPER, .	13	CLONDERLAW, . .	1

XVII.

DISCOVERY OF HUMAN AND OTHER REMAINS, WITH MATERIALS SIMILAR TO THOSE OF A CRANNOGE, HIGH ABOVE THE PRESENT VALLEY OF THE BLACKWATER BETWEEN LISMORE CASTLE AND CATHEDRAL. BY R. J. USSHER.

[COMMUNICATED BY E. P. WRIGHT, M.D.]

[Read APRIL 26, 1897.]

IN the autumn of 1891, for the purpose of draining the town of Lismore, a deep trench was cut along the road leading from the court-house to the bridge. My examination of this cutting resulted in the following notes, made at the time, with slight modifications:—In the cutting is a layer of peat which extends north and south of the turn-stiles leading to the cathedral.

In this and in the adjoining rubble I saw several oak piles, tapering to a long point, driven at intervals of several feet.

I also picked up among the rubbish thrown out of the trench, as well as out of the matrix of peat *in situ*, many bones of ox, pig, goat or sheep, as well as of red deer. Of the latter I found portions of skulls and antlers, and saw portions of antlers and tines of antlers cut off with a saw with one clean cut.

I picked up among the *débris* thrown out of the trench a bone object which I believe to have been used as a marrow scoop, similar to those I have often found in raths. One of the tines of the red deer in the possession of Mr. L. M. Fitzgerald had the surface worn smooth.

November 6th, 1891.—At a depth of 3 feet 6 inches in the cutting a little way to the south of the wicket-gate and turnstiles two human skeletons were discovered, of which I obtained the crania and several other portions of the skeletons. I took out of the matrix in the trench a humerus, os innominatum and femur. The skeletons lay together without any cist of stones or wood, in dark earth beneath a layer of peat or rushes, timber, and stones mixed with peat. I preserved a mass of material like rushes or other stems, and a slab of

timber that I took out from over the skeletons. The stakes that had been driven into the peaty stratum were imbedded vertically in it.

From the surface of the road, earth with stones extended to a depth of two feet. The peaty stratum and dark earth containing the skeletons extended eighteen inches deeper, to the bottom of the trench at least.

Near the wickets a great assemblage of bones of oxen had been dug out. These consisted largely of lower jaws and the long bones. I selected a forehead and horns of the ancient flat type, also broken crania of horse, pig, and goat, and a portion of a skull bearing on it the bos of the antler of a red deer. I was given a tine of an antler of the latter by one of the workmen.

These are the species of animals whose remains commonly occur near all raths and crannoges in Ireland, in all at least that I have examined in the counties of Waterford and Cork.

There were some large pieces of oak (?) timber in the cutting. I heard of a piece of metal found in the cutting, but thrown away. Mr. Stokes, the contractor who executed the works, said that oyster-shells had been found in it.

Near the entrance of the Castle avenue I saw a quantity of the burned stones and black earth, that indicate an ancient cooking place, thrown out of the trench.

Near this some human remains that I did not see had been found at no great depth.

We have in this find the usual indications of an Irish camp or settlement; but if the layer of rushes and peat, with pointed oak piles driven in vertically, are to be taken as remains of a crannoge, great changes must have taken place in the configuration of the district: a crannoge could only have existed in a lake basin, but at the present day the ground slopes down rapidly from the site of the discovery to the deep Blackwater valley some sixty feet below. Consequently if a lake had formerly existed (as the peat indicates) the present river-valley could not have been excavated, and must have been a thing of subsequent formation from natural causes.

It would be well to have the spot examined in detail by a qualified geologist.

XVIII.

ON SOME HUMAN REMAINS RECENTLY DISCOVERED NEAR LISMORE. By D. J. CUNNINGHAM, M.D., F.R.S., AND C. R. BROWNE, M.D.

[Read April 26, 1897.]

The remains described in this Paper were, some time ago, dug up during the progress of some drainage works at Lismore, in what appeared to have been a crannoge, and were forwarded to the Anthropological Laboratory, Trinity College, by the discoverer, Mr. R. J. Ussher, who has described the nature of the sepulture and the circumstances of the find in the previous Paper. The bones which are of a reddish-brown colour from the nature of the soil in which they have lain, and brittle from loss of animal matter, present many points of interest. They appear to have belonged to two individuals; one a female of small stature and about middle age, the other a young man somewhat above the middle height and of considerable muscular development.

The remains submitted to us for examination consist of a cranium, a mutilated calvarium, an inferior maxilla, right scapula and humerus, two radii, two ulnæ, a complete pelvis, a much mutilated os innominatum, three lumbar vertebræ, and two left femora.

The bones belonging to each subject are as follows:—No. 1 (the female). Cranium, right scapula, right humerus, part of the left os innominatum, the left femur. No. 2. Part of the cranial vault, consisting of os frontis, and both parietals with a small epactal, the mandible, bones of both forearms, the pelvis (the sacrum a good deal broken), the left femur and the first three lumber vertebræ.

No. 1. *Cranium.*—This is well shapen and of a high type, and evidently that of a female of middle age. It is moderately brachycephalic (index 80·8), and of small size, its cubic capacity being only 1295 cubic centimetres. The forehead is broad and upright, the frontal eminences fairly well marked, and the vertex flattened. The glabella and superciliary ridges are well developed for a female, and the mastoid processes are small. The sutures are complex (No. 4 Broca), but to a large extent obliterated, the spheno-parietal sutures

being entirely closed, and the sagittal obliterated from the lambda to the obelion.

The face is broad, with oblong megaseme orbits set somewhat far apart; the nose is platyrhine. All the teeth were present at time of death, with the exception of the second molar on the right side, which had been gone for some time, as the socket was absorbed. They are sound, but very much worn on the crowns, as is usually the case in the teeth of ancient Irish crania. This attrition may be attributed to the tough and gritty nature of the food.

The cranium is in good condition, though brittle, and has only one mutilation, a triangular depressed fracture, 40 mm. long by 29 mm. wide at the base above, and somewhat encroaching on the upper border of the right orbit. This fracture appears to have been caused by some injury inflicted in the course of excavation.

When examined, the cranium was found to contain a globular pellet, 5 or 6 centimetres in diameter, which proved to be portion of the cerebellum, covered by a thick coating of a black, oily-looking earth, which was with difficulty removed from the cheese-like brain substance.

It was found necessary to divide this pellet into four parts in order to allow of its removal from the cranial cavity through the foramen magnum; and, on examination of the cut surfaces, it was evident that the portion of brain preserved was part of the cerebellum. The folia and fissures were easily distinguishable. The four parts of the pellet were hardened in alcohol, embedded in celloidin, and cut. They cut with extreme ease, and sections of almost any degree of thinness could be obtained, but the result was in a measure unsatisfactory. The fissures and folia could still be made out in the sections, but not so clearly as in the mass. By no method of staining could any details of minute structure be detected. The constituent parts were broken up into an indistinguishable mass.

Scapula.—This bone is very light and fragile: the coracoid process has been broken off: the supra-scapular notch is large. The measurements and indices are:—

Length,	152 mm.
Breadth,	97 ,,
Breadth index,	63·8 ,,
Infra-spinous length,	109 ,,
,, index,	88·9 ,,

The humerus is rather slender, and has slight muscular markings. It is not perforated. Its length is 317 mm.

Os innominatum.—The left os innominatum, sole remnant of the pelvis of this skeleton, is so extensively broken that there is not enough of it left to give definite points for measurement.

Femur.—The left femur measures 428 mm. in length, and is remarkable for the prismatic shape of its shaft, which is so marked as to justify this specimen being classed as an example of pilaster femur. The neck of the bone is set at nearly a right angle to the shaft.

Conclusions.—Judging from the shapes and markings of the cranium and other bones, this subject would seem to have been a female of from 45 to 50 years of age. In the absence of both segments of either the uppor or lower limb, the stature had to be calculated from the lengths of the femur and of the humerus. Taking the length of the femur to be 27·4 per cent. of the stature, as given in M. Topinard's Tables, the stature would be 1·562 m., or about 5 ft. 1½ in. If the stature is calculated from the length of the humerus, nearly the same result is obtained, viz. 1·575 m., or 5 ft. 2 in.

No. 2. *Cranium.*—There is not enough of the brain-case of this subject left to afford the actual cranial indices; but judging from what remains the cranium would seem to have been brachycephalic, like that of No. 1, but probably to a greater extent. The bones of this specimen are very thin and light, and the sutures, which are very complicated, indicate by their entire freedom from any trace of obliteration that the cranium was that of a young person.

Mandible.—This is noticeable for its great inter-condyloid width as compared with its length. It was fractured across a little to the left of the symphysis in the process of exhumation. The teeth are rather worn on the crowns, with the exception of the third molar on each side. These were both intact, and well developed, and had not been long erupted, as they bear no marks of wear.

Bones of the forearms.—The bones of the forearms differ very slightly from each other in size and characters. Both forearms are pretty long, with fairly strong muscular markings and epiphyseal lines not fully joined. *Radii.*—The right radius measures 263 mm. in its greatest length, or 250 mm. between its articular surfaces; the left 261 mm. in its maximum length, or 249 mm. from articular surface to articular surface. *Ulnæ.*—The same slight difference existed between the ulnæ; the right measuring 284 mm. in length, or 280 between articular surfaces; the left 282 mm., and 278 mm. between the same points. It is a matter for regret that a humerus of this

skeleton was not found along with the bones of the forearm, as from these the radio-humeral index could have been obtained.

The pelvis is almost entire, though very light and brittle, the only injury it has sustained being the loss of the lower part of the sacrum. The ilia are non-translucent, and but slightly expanded. The Y-shaped junction of the three primary portions is quite visible in both ossa innominata (especially in the left where it is very evident), and the epiphyses are marked off by clear boundary lines from the rest of the bones. The junctions of the parts of the sacrum are not fully closed.

The measurements of this pelvis, when set up, are—

	m.m.	
Breadth,	287	Breadth index, 76·7.
Height,	220	
Breadth at anterior superior spines,	247	
,, posterior ,, ,,		(both spines broken).
,, ischial tuberosities,	138	
Cotyloid height,	55	
,, breadth,	57	
Obturator height,	63	Obturator index, 63·5.
,, breadth,	40	
Transverse diameter of cavity,	133	Pelvic index, 78·9.
Conjugate ,, ,,	105	
Right oblique diameter,	123	
Left oblique ,,	128	
Internar intertuberal,	87	
Depth of symphysis,	54	
,, pelvic cavity,	102	

The above given measurements were all taken by Sir William Turner's method. The pelvis, from its shape and dimensions, appears to be that of a young male somewhat above the middle stature.

Lumbar vertebræ.—Only three vertebræ—the first, second, and third lumbar—were received, but these fortunately were in good condition. They belonged to a young person, as is shown by the non-obliteration of the epiphyseal lines. The measurements of these bones are—

1st lumbar vertebra :—

Anterior height,	26 mm.
Posterior ,,	31 ,,
Vertebral index,	119·2

2nd lumbar:—

Anterior height,	29 mm.
Posterior ,,	31 ,,
Vertebral index,	106·0

3rd lumbar:—

Anterior height,	29 mm.
Posterior ,,	27 ,,
Vertebral index,	93·1

The composed vertebral index obtained from these three vertebræ is therefore 106·1.

The relation which these figures bear to those of the average European, and especially to the modern Irish spine, is a very close one, as may be seen from the following figures. (*Vide* No. 2 of the Royal Irish Academy "Cunningham Memoirs.")

Average index of the first three lumbar vertebræ:—

43 Irish males,	102·2 (maximum 114)
22 Irish females,	98·5
76 "Europeans,"	101·5
17 Australians,	110·6
11 Negros,	110·2

The sudden fall of the vertebral index of the third lumbar vertebra, as compared with the first and second, is fairly common in Europeans, but has not been observed in Australian or Tasmanian spines. It was noted once in ten Negro males, and three times in nine Andaman females.

Femur.—The femur is large and strong; its shaft is prismatic on cross-section, the linea aspera being so developed as to constitute the condition known as "pilaster femur." A trochanter tertius is present, and the insertion of the glutens maximus is marked by a deep, roughened impression. The neck of the bone is set very obliquely to the shaft. The length of the bone is 477 mm.

Conclusions.—The bones of this subject are those of a powerfully built young man, of between twenty and thirty years of age, and of a stature, as calculated from the length of the femur and of the bones of the forearms, of about 1778 mm., or 5 feet 10 inches.

The skeletons have many characters in common; the crania are in both cases brachycephalic and of the same type, and both femora belong to the class of pilaster femur.

The points telling most in favour of the antiquity of the specimens, besides the nature of the sepulture and surroundings in which they were found and the friability of the bones, are the two femora,

being of the pilaster type so rare in modern specimens, and the grinding away of the crowns of the teeth, a character commonly found in ancient Irish teeth.

The preservation of the brain-matter by the action of peat is not unprecedented, as there are several instances on record in which brain-matter has been so preserved in crania.

Measurements of Cranium.

Sex,	F.
Age,	Adult.
Glabello-occipital length,	177
Ophryo-occipital length,	175
Maximum breadth,	143
Minimum frontal breadth,	90
Bi-stephanic breadth,	113
Bi-asteric breadth,	116
Basio-bregmatic height,	129
Frontal longitudinal arc,	118
Parietal longitudinal arc,	120
Occipital longitudinal arc,	118
Nasio-opisthial arc,	356
Foramen magnum length,	32
Basio-nasial length,	97
Total sagittal circumference	485
Auriculo-nasial radius,	91
Auriculo-bregmatic radius,	116
Auriculo-bregmatic arc,	305
Horizontal circumference,	507
Cubic capacity,	1295
Facial.	
Nasio-alveolar length,	62
Bi-zygomatic breadth,	126
Bi-dacryc breadth,	24
Basio-alveolar length,	93
Auriculo-alveolar length,	95
Bi-malar breadth,	113
Nasal length,	48
Nasal breadth,	28
Orbital breadth,	40
Orbital height,	31
Palato-maxillary length,	53
Palato-maxillary breadth,	59

Indices.

Cephalic,	80·8
Altitudinal,	72·9
Auriculo-vertical,	65·5
Fronto-zygomatic,	89.7
Gnathic,	95·8
Auriculo-gnathic,	104·3
Upper facial,	49·2
Nasal,	58·3
Orbital,	77·5
Palatal,	111·0

XIX.

REPORT ON A PREHISTORIC BURIAL NEAR NEWCASTLE, COUNTY OF WICKLOW. By GEO. COFFEY, C. BROWNE, M.D., AND T. J. WESTROPP, M.A.

[Read June 14, 1897.]

Mr. R. J. Moss having kindly reported to the Secretary of the Royal Irish Academy on the 24th May, 1897, that a chamber containing human remains had been discovered near Newcastle, in the county of Wicklow, we at his request visited the locality on the day following. The re-

Fig. 1.

mains were found on the farm of Mr. S. J. Sutton in the southern townland of Blackditch, parish of Killiskey, about a mile and a quarter south-east of the village of Newcastle. (Ordnance Map, Sheet 19.) The circumstances of the discovery were as follows:—While breaking up a grass-field the plough struck against what was thought

to be a rock, about six inches below the surface of the field. On clearing the stone it proved to be a large granite block forming the cap-stone of a cist, the stones of which are of unusually large dimensions (see fig. 1).

The structure is formed of four blocks of schist, the interior measuring 5 feet long, the north stone being 7 in. longer. The cist was 2 feet 4 inches wide, except at the west end where the irregularity of the south block made a narrow recess 8 inches wider. Its height is on the average 2 feet high, and its floor was paved with small flagstones which had been removed before our visit. The covering stone is a block of even-grained granite of irregular shape rising into a roof-like ridge lying almost due east and west, while the axis of the chamber lies E.S.E. and W.N.W. The east end has been removed; it varied in width from 1 foot 8 inches to 2 feet 4 inches, and was (like the uncovered ends of the sides) 7 inches or 8 inches thick and 2 feet high (fig. 2).

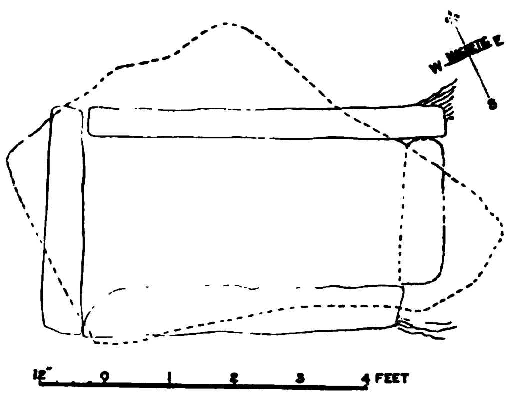

FIG. 2.

Before we visited the site, Mr. Sutton had caused the excavations to be filled in, having first collected the bones of the skeleton in a sack, which he placed in the chamber. He kindly reopened it for our inspection. A very intelligent labourer, who had taken part in the original excavation of the chamber, described to us the position of the body when found. We have no reason to doubt but that his description is substantially correct. The body he states lay on its right side, with the head to the west, the legs contracted, the feet being in the north-east corner. No certain information could be obtained as to the position of the hands, except that they were away from the head, and

some distance apart from each other. The head is stated to have lain partly on its back.

The grave was not carefully searched when opened. Subsequently some boys entered the chamber, and are said to have found an urn. The urn was unfortunately broken in pieces, either through careless handling or intentionally, and the fragments dispersed. Two pieces were recovered by Mr. Sutton and shown to us. They are of th usual "food vessel" type so frequently associated with this class of interment.

The skeleton is said to have been entire at the time of its discovery, but the skull and most of the long bones were much damaged and broken, and the spongy bones were reduced to powder by rough handling before we arrived. All the bones are very fragile and brittle from loss of animal matter and very much weathered, those of the right side, on which the body is said have lain, much more so than those of the left; in fact from damp they are much reduced in size. The bones recovered and kindly given us by Mr. Sutton were, the calvarium, much broken (the skull had been entire at the time of the find, but had suffered from rough handling), the inferior maxilla, fractured across a little to the right of the symphysis. Both clavicles, upper third and head of right humerus, lower two-thirds of left humerus, both ulnae (the right greatly weathered), the left radius, lower part of right radius, two cervical and two lumbar vertebrae, part of right acetabulum, right femur, upper two-thirds of left femur, head and upper half of left tibiae, lower ends of both tibiae, left os calcis and astragalus.

The calvarium was in fragments at the time it came into our hands, but has been set up for measurement; it is much weathered and broken, most of the base and the right temporal bone being gone. It is of considerable size, and well shapen. Viewed in *norma verticalis* it is a broad oval in outline; in *norma lateralis* the forehead is seen to be upright. The glabella and superciliary ridges are of fair size, the mastoid process is large and laterally bulged, as noticed in the crania found in the tumulus at Old Connaught, Bray, in 1893.

The sutures are fairly complex and contain two ossa wormiana, in the lambdoid suture, one just at the lambda and the other just above the right asterion. The metopic suture is open. The sagittal suture is obliterated for about 50 mm. at the obelion. Though the right temporal bone is missing, yet as the maximum breadth is evidently parietal the cephalic index is obtainable, the skull was mesaticephalic with an index of 79·4.

The characters of this calvarium indicate that it belonged to a male of about 40 years of age.

The inferior maxilla is fractured across to the right of the symphysis, the right side is much weathered and reduced in size by the damp. All the teeth were present at the time of death, the sockets being unabsorbed, but only three remain *in situ*; these are much worn away on the crowns, as is usually the case with the teeth in ancient Irish crania. The mental process is very well marked.

But little can be said with respect to the other bones; they possess no special characters and are much weathered, but are stout and evidently belonged to a man above the middle height. The left humerus is not perforated. The left ulna and radius are entire; the ulna measures 286 mm. in extreme length, 255 mm. between articular surfaces; the left radius measures 273 mm.

The femora have the head set into the shaft at a very obtuse angle; they are much weathered and the left is broken. The right femur measures 498 mm.

The upper part of the shaft of the left tibia is very narrow and flattened from before and backwards, but the specimen is so weathered that it is difficult to say whethor this is due to decay or to the presence of the condition known as platychnemia.

The bones seem to be those of a man of about 40 years of age and of above the middle stature, the height as calculated from the femur (taken as 27·4 m. of the stature) being 1817 mm. or 5 feet 11½ inches.

Cranial Measurements.

Glabello-occipital length,	189
Ophryo-occipital length,	187
Maximum breadth,	150
Bi-stephanic width,	121
Bi-asteric width,	116
Frontal longitudinal arc,	142
Parietal longitudinal arc,	133
Occipital ,, arc,	113
Nasio-opisthial arc,	388
Spheno-parietal suture,	10
Cephalic Index,	79·4

XX.

ON THE CONSTITUTION OF THE CALP SHALE OF THE NEIGHBOURHOOD OF DUBLIN. By PROFESSOR J. P. O'REILLY, C.E., Royal College of Science, Dublin.

(Plate XI.)

[Read April 12, 1897.]

The beds of the Carboniferous formation which show themselves in the many quarries which have from time to time been opened up and worked in the vicinity of Dublin, are marked by the Geological Survey as belonging to the *middle* or "*Calp Limestone*" series. This term or designation is found for the first time in Kirwan's "Mineralogy," 2nd edition, vol. i. (1794), wherein at p. 233, under the heading of "*Basalts*," he mentions "*Calp*" or *black quarry stone of Dublin*: and having given some of the characteristics such as the density = 2·646 to 2·7, and its fusibility at 130° of the pyrometer of Wedgewood, he states that:—"It seems to be the calcareous trap of Lasius Hartz, 170; at least this agrees with its colour, sp. gr., and in containing calcareous matter." The next mention that is found of the term is in "Griffith's Report on the Leinster Coal Fields." In the Introduction (p. iv), he says:—"Slate clay, either black, grey, or reddish grey, is another supposed indication of Coal and is certainly common in all coal countries, but not peculiar to them. This rock is frequently found alternating with Limestone and particularly with that species called '*Calp*' which occurs in the neighbourhood of Dublin."

He also adds at p. viii of Introduction:—"Slate clay is sometimes so compact that it resembles jasper. In the Kilkenny coal district, instances frequently occur of its passing, by insensible gradations, from soft clay slate into a siliceous slate rock resembling Lydian stone. This gradation is frequently visible in this district, near the junction of the limestone with the rocks of the Coal formation."

In Jukes' "Manual of Geology," 1857, p. 446, when describing the Carboniferous formation in "Clare, Limerick, Tipperary, Kilkenny,"

&c., he assigns to the "Calp" or middle limestone a thickness of 1400 to 1000 feet, and says of it:—"The 'Calp' consists of black limestones, sometimes very earthy, interstratified with black shales, so that they become in some places more important than the limestones. The limestones of this group are usually unfit for burning into lime. Chert beds and nodules are very abundant in the 'Calp.'"

In the second edition of this work (Jukes' and Geikie's "Manual of Geology," 1872), it is stated, at p. 589:—"The Carboniferous limestone of the south of Ireland is perhaps one of the largest aggregates of beds of limestone to be seen anywhere in the world. In some places it contains beds of black shale, and becomes earthy in its middle portion, and sometimes the whole of it, except the lower part, puts on this shaly and earthy character. This middle earthy and shaly part has been called '*Calp*' from a local term signifying '*black shale.*' Black chert is often developed in the limestone, rows of nodules and seams of it appearing in great abundance, sometimes in one part and sometimes in another."

It is stated at p. 595:—"The great Carboniferous limestone series of Ireland contains evidence that here and there, at various intervals during its formation, minor volcanic vents were active in different parts of the sea bottom. In the county Limerick masses of trap 1200 to 1300 feet thick, with well marked ashy interlacings lie amongst the limestones."

In the Explanation to Sheets 102 and 112 of the Geological Survey (1878), p. 7, it is stated:—"Hitherto these black shales and the beds between them and those assigned to the lower limestone have been mapped and spoken of as '*Calp*' both by Sir Richard Griffith and in the Index Map of the county of Dublin published by the Geological Survey in 1851. 'Calp' seems to be a local provincial term for 'black earthy stone' or shale, and in that lithological sense it is perfectly applicable to all these upper beds, so much so, that it is impossible to separate the dark earthy limestones which overlie the lower limestone into two groups of beds, differing either in lithological or palæontological characters."

Page 25. In all the Dublin district, however, the beds are supposed to belong to the upper dark "Calp" division of the limestone series, including some more purely calcareous and fossiliferous beds stretching east and west near Crumlin.

It will thus be seen that the term "Calp" originally applied by Kirwan to a rock which he classed with the traps, has subsequently been applied to the black shales which so largely constitute the middle

part of the Carboniferous limestone in Ireland. It is not, however, clearly explained in what particular locality or province the term "Calp" originated, or was applied, to these particular rocks; nor can it at present be stated to what language the word properly belongs, and what is its true and proper signification.

It is remarkable that Kirwan should have taken into consideration the colour of the shale as it usually presents itself either in the quarry or in buildings as a stone. This character struck me, since having observed that there is nearly always present iron pyrites in minute crystals, I remarked the continuous decay and exfoliation of the stones where exposed to the atmosphere, though without any appearance of oxydation so far as the iron is concerned. I was consequently led to examine more attentively the constitution of the shale, and taking at haphazard the first specimen that came to my hand, I treated it with HCl with a view to determining the nature of the insoluble residue. This I found to be abundant, flocculent, and of a dark brownish colour. The density of this part was low and not immediately explainable as characterising a purely sedimentary rock. Having continued to separate this insoluble portion of the shale, I had enough to enable me to have a complete analysis made of it by Mr. Wm. L. Warren, F.C.S., and obtained from him the following as his Report:—

	Percentage.
SiO_2,	62·01
Fe_2O_3,	4·87
FeO,	0·06
Al_2O_3,	15·05
CaO,	9·95
MgO,	3·25
MnO,	0·12
CuO,	trace
Na_2O,	3·01
K_2O,	0·40
S,	1·06
Chemically combined moisture,	0·36
	100·14

It is evident that in this analysis the sulphur is to be counted as iron pyrites, while some of the lime may be accounted for by the incomplete removal of that constituent of the rock by the action of the HCl.

Allowing for these it will be observed that the composition corresponds roughly with that of a "*pumice*" or obsidian. In order to determine how far this estimate might be correct, two specimens of calp were taken from Finglas quarry; the one a relatively pure limestone (No. 74), the other a calp shale (No. 75). Both were pulverized and treated with HCl until the lime was removed as far as possible. The residues were then submitted to Mr. Warren who sent in the following Reports of the analyses:—

	(No. 74). Percentage.	(No. 75). Percentage.
SiO_2,	78·66,	75·02
Al_2O_3,	10·80,	12·57
Fe_2O_3,	—	—
FeO,	5·25,	4·19
MnO,	—	trace
CaO,	0·71,	1·14
MgO,	0·93,	1·72
Na_2O,	0·32,	1·01
K_2O,	trace,	0·26
P_2O_5,	trace,	—
S,	3·21,	4·02
Moisture and organic matter,	0·41,	0·11
	100·29	100·04

Nos. 74, 75.—"Received in the form of a black, ground powder, containing small quantities of pyrites, which have been calculated, as shown in the above analyses."

"Both samples were carefully examined for rare metals of the I., II., III. and IV. groups, but only the very minutest trace of TiO_2 was found in No. 75."

Parts of these same residues were treated with nitric acid in order to completely remove the pyrites present, which owing to the fineness of its state of division could not be perfectly separated by panning.

The densities of these final residues thus freed from pyrites were found to be:—

No. 74 (calp limestone residue) $D = 2·124$.
No. 75 (calp shale residue) $D = 2·074$.

These densities are characteristic of pumices, while the composi-

tions above given correspond fairly with the analyses of well-determined pumices, as shown in the following analyses:—

	Pumice from Lipari, Klaproth. (Gregg and Letsom.) Percentage.	Obsidian from Telkibanya, by Erdmann. (Gregg and Letsom.) Percentage.
SiO_2,	77·50,	74·80
Al_2O_3,	17·50,	12·40
Fe_2O_3,	1·75,	2·03
FeO,	—	—
MnO,	—	1·31
CaO,	—	1·96
MgO,	—	0·90
Na_2O,	—	—
K_2O,	—	6·40
P_2O_5,	—	—
S,	—	—
Moisture and organic matter,	3·00,	—
	99·75	99·80

Taking the compositions as determined and above mentioned, in connexion with the low densities found, and also with the hardness of the residues which scratched glass after the manner of pumice, it may be allowed that the sum of these characters is sufficient to determine these calp residues as being pumices in part.

In order to substantiate this view thin sections of the rocks were made and examined.

Taking the Finglas calp as an example (see Pl. XI., fig. 1), this under a power of 40 and by ordinary transmitted light showed a light brownish or sepia-coloured ground mass, or matrix, finely granular in places, and presenting porphyritically dispersed therein granules and fragments of what appeared to be fragments of shells or spicules; with these occur iron pyrites replacing more or less completely the matter of the fragments of shells or spicules. Under polarized light and crossed nicols the fragments showed the presence of lime carbonate, sometimes recognizable by its cleavages.

In most cases the alteration of the fossils had reached the point of the complete replacement of the original body, so that the organic structure is either completely obliterated or very imperfectly shown. Under a power of 80, some of these forms are, however, recognizable,

and in the case of the foraminiferous structure shown in the drawing it might be a portion of a radiolarian (see Pl. XI., fig. 2). As, however, the characters shown by the thin section under polarized light did not satisfactorily show what might be the nature of the brown granular matrix, a section was prepared and submitted to the action of dilute hydrochloric acid. The carbonates of iron and lime were thus removed, and there remained unacted upon a brown, largely reticulated, residual part, which under crossed nicols behaved as an isotropical body, while here and there chips or small flakes of double refracting colourless minerals showed themselves, some with the weak refrangibility of the microlites characteristic of most natural glasses, and some large and more markedly refracting presented the characters of a sanadine or nepheline. This brown residue appeared to be quite black by transmitted light, but by ordinary diffused light showed a brown colour and a granular structure, presenting the appearance, as a whole, of a dark brown soft sugar. From this test the inference is drawn that the brown matter in question is mainly composed of particles of pumice enclosing fragments of spicules, radiolarians, and other such marine forms.

Considering the frequence of the volcanic outbursts during the Carboniferous period, and the proved existence already referred to of eruptive rocks in the formation, it would be quite in conformity therewith to find proofs of the ejection of pumice as a part of the volcanic activity of the period. And presuming that the shale beds represent deep-sea deposits formed relatively far from land, it might be expected that they would show the presence of pumice when carefully examined. This association of pumice with deep-sea deposits is one of the facts markedly brought out by the soundings of the "Challenger" expedition. As to the presence of the fossil remains with the pumice that is easily accounted for, if consideration be taken of the fact that pumice not only floats at the surface of water, but that as a result of a volcanic eruption immense extents of ocean surface may be covered with a thick bed of it. One of the many notable instances of this came under my notice immediately after the eruption of Krakatoa. A gentleman residing in Dublin, and connected with a large firm of importers in the city, received from a captain of a ship which arrived from Eastern waters, and which had been in the neighbourhood of the celebrated eruption, specimens of the mass of pumice with which the surface of the sea had been covered in consequence of that eruption, and I was able to get from him the following details relative thereto, giving also the ex-

perience of another captain as well as his own during and subsequent to the Krakatoa eruption:—

> "Ship 'Venezuela' was at Samarang on the 27th August (1883): there was intense rain in the evening; pumice was first observed in lat. 6° 43′ S., and long. E. 104° 1′. The vessel sailed through about 200 miles of it. The barometer was very high in the morning and very low in the evening. There was dust floating like a scum, about 9 inches thick, on the water and pieces of pumice floating here and there in it.
>
> "Ship 'Mei Nepoti.'—On the 26th of August was in Batavia. The captain on going on board in the evening noticed the sky to be very black, as if a squall about to come on; heard explosions from 12 o'clock until 4 o'clock next morning (27th). On the 27th the dust fell from 12 o'clock noon until 3 o'clock p.m. After 4 o'clock a.m. heard no more reports. At 8 o'clock a.m. of the 27th all the ships in the roads spun once or twice round their anchors. There was darkness from 8 o'clock a.m. till 1 o'clock p.m. on the 27th; then noticed the tide to rise three times, at 1½ o'clock, 3 o'clock, and 8 o'clock p.m. of the same day, and the red pumice (of which a specimen contributed by the captain) was picked up on the 28th October in long. 97° 20′ E., and lat. 13° 20′ S."

These notes furnish evidence not merely of the vast amount of pumice ejected on that occasion, but of the existence of a scum of fine pumice dust (such as might be represented by the matrix of the section referred to), 9 inches thick and of vast extent. Such a scum would, before becoming completely waterlogged and sinking to the bottom of the ocean, become inhabited by minute marine organisms, such as small sponges and radiolarians, and in sinking would carry them down and become deposited on the bottom of the sea as these calp shales were. Taking into consideration the vast thickness of this formation in Ireland and assuming that in general the calp shales are largely composed of fragments of pumice as in the particular case under consideration, may it not be inferred that they measure more or less completely the volcanic activity of the periods to which they have been referred, and in this manner add to the data furnished by the trap rocks which have been fully described by the authors mentioned as characteristic of the Carboniferous formation in Ireland.

XXI.

STUDIES IN IRISH CRANIOLOGY: III. A NEOLITHIC CIST BURIAL AT OLDBRIDGE, COUNTY OF MEATH. By ALFRED C. HADDON, M.A., D.Sc.

(Plate XII.)

[Read January 25, 1897.]

A year ago I had the pleasure of examining, in company with Mr. G. Coffey, a cist in the property of Lt.-Col. J. Coddington, J.P., at Oldbridge, Drogheda, county Meath.

The cist was accidentally discovered on December 20, 1889, in removing some stones which interfered with the ploughing of the field in which it occurs. It is situated on the top of a hill locally called "The Mountain," and Colonel Coddington has very wisely erected a wooden shed around the monument in order to preserve it. He has also affixed to the door of the shed a metal plate on which is stamped a record of the find.

The cist is built up of four slabs of stone resting on the ground which supported a large covering slab. The cavity measures some 3 feet 2 inches (970 mm.) in length; 1 foot 9 inches (535 mm.) in breadth, and 1 foot 6 inches (460 mm.) in depth. The long axis is orientated about N.E. by E. The stones are of local origin; the covering-stone is a greenish flag, and is pitted on its original under-surface with four depressions which are rather like cup-markings.

In the south-west corner there were found the cranium, which I am about to describe, and close to it an urn containing some burnt ashes. In the centre of the cist were heaped six large bones with fragments of smaller ones on the top. Marks of fire were observed on the sides of the cist, and on the under side of the covering slab. The cranium and urn are now in the possession of Colonel Coddington.

Mr. Coffey has kindly assisted me in drawing up the following

short description of the urn, and I am indebted to him for the photograph of it:—

The urn is of the type usually called "food-vessel" (fig. 1). Its dimensions are 4½ inches (115 mm.) high, 5¾ inches (146 mm.) in diameter at the rim, 6 inches (150 mm.) in greatest diameter, and 2⅛ inches (54 mm.) in diameter at the foot. The ornamentation consists of horizontal bands of zigzag and herringbone patterns and bands marked with horizontal lines. The patterns are formed by serial repetitions of impressions made by two kinds of stamp, the zigzags were evidently produced by a small, semi-circular stamp, reversed alternately above and below; the herringbone pattern and

FIG. 1.

horizontal lines were impressed by a small toothed stamp. In details of the decoration the reader is referred to the illustration (fig. 1). The underside of the small base is decorated with a star having five broad rays, the field is marked with rudely scored oblique lines.

Mr. Coffey informs me that the ornamentation and basal decoration of this urn are very characteristic of the low globular urns most frequently found with incinerated interments, but the shape of the urn is, perhaps, transitional between these and those food-vessels which have a well-developed foot. Sufficient data have not, however, yet been collected for a systematic arrangement of Irish urns.

Description of the Human Remains.

At the time of my visit there were only a few fragments of the skeleton in the cist, and with the exception of portions of a right femur, these were too broken to be of the slightest value.

The femur is incomplete, and in three pieces, but there is sufficient of it left to prove that it belonged to a powerful man: the shaft is decidely curved, and the muscular impressions are prominent. It is impossible to measure the femur, but by comparing it with other femora one may put down the man as probably being about 5 feet 10 inches (1780 mm.) in height. The mean height of the Neolithic dolichocephals was probably about 5 feet 4 inches (1625 mm.), while that of recent Irishmen is 5 feet 7½ inches (1713 mm.).

Colonel Coddington had previously abstracted the cranium which he had then lent to Dr. Frazer to examine, and he authorised the latter to lend it to me to measure and photograph. I take this opportunity of thanking Colonel Coddington for this permission, and for other kindnesses shown towards me.

The cranium is that of an old male, of which the whole face is absent, as well as the squamosal, temporal, and base on the right side; the left zygomatic arch is broken.

The glabella and supra-ciliary ridges are very prominent (No. 4, Broca), and the external orbital processes are stout. The ophryon is flat and depressed, the frontal eminences are moderately well marked. The forehead is broad, and would probably appear somewhat receding in the norma lateralis were it not for a median keel. This sagittal frontal keel becomes very broad on the upper part of the frontal, where it attains a maximum breadth of about 27 mm., the broad portion narrows rather rapidly into the sagittal frontal keel about 65 mm. from the bregma. The temporal portion of the frontals has vertical sides, that is, the frontals are ill-filled laterally. The temporal crest is well marked. The parietal region has a low vault; there is a slight sagittal keel which, however, does not extend anteriorly to the bregma, which is flat, and it also disappears at the level of the parietal eminences. The latter are fairly prominent, and at this region the sides of the cranium are fairly vertical. The distance from one side to the other at the stephanion is 114 mm. in the direct line, and 129 mm. along the curve; the central point of the parietal eminences are distant from one another 119 mm. in the direct line, and 133 mm. along the curve. The occipital squame is somewhat

protuberant, but the bone is here much corroded; the superior curved lines are very strong, but there is no external occipital crest. The nuchal region of the occipital is rather flat, but with a pair of lateral swellings; the inferior curved lines extend to the base of the mastoids, both of the latter are broken, but, judging from the base of the one on the right side, these were of large size.

The sutures are very simple; the sagittal is entirely, and the lambdoidal almost totally obliterated. The coronal, which has a complication corresponding to No. 2 of the Broca scale, is beginning to be obliterated, especially about the bregma. Both pterions are in H; that on the right side appears to be 14 mm. in width. There are no wormian bones.

Norma verticalis.—Oval, irregular at occipital protuberance and at glabella, due probably to a slight posthumous distortion, apparently the result of the skull lying on its left side. It belongs to the ovoides group of Sergi,[1] but the sides in front of the parietal eminence are straighter than in the typical examples of that group.

Norma lateralis.—Prominent glabella; above the ophryon the low even curve of the cranial vault is continued to the lambda; it is very slightly flattened at the bregma and obelion; there is a slight occipital protuberance about the lambda; then the contour is vertical to the inion where it suddenly recedes. On the whole the form is nearest to Sergi's isobathyplatycephalus (or isobathys siculus), and agrees very closely with the figure he gives of a Neolithic Sicilian skull, although the forehead is not so full and rounded as in the latter.

Norma occipitalis.—A low pentagon with a somewhat rounded roof.

The following are all the measurements I was able to make:—Glabello-occip. length, 196; glabello-inial length, 188; ophryo-occip. length, 191; maximum (parietal) breadth, 144; maximum frontal breadth, 125; bi-stephanial breadth, 125; ~~maximum~~ frontal breadth, 105; basio-bregmatic height, 139; frontal sagittal arc, 140; parietal sagittal arc, 124 (?); occipital sagittal arc, 123 (?); nasio-opisthial arc, 387; foramen magnum length, 34·5; basio-nasial length, 110; total sagittal circumference, 532; auriculo-nasial radius, 104 (?); auriculo-bregmatic radius, 125 (?); auriculo-parietal radius, 125 (?) horizontal circumference, 540.

The length-breadth index is 73·5 (the ophryo-occip. index being 75·4); the length-height index is 70·9, and the breadth-height index,

[1] "Origine e Diffusione della Stirpe Mediterranea," p. 133, fig. 25.

96·5; taking the auriculo-radial measurements the length-height index is 63·8, and the breadth-height index is 86; but the two latter indices are only to be regarded as approximate, owing to the difficulty of getting accurate radial measurements. The cranium is therefore dolichocephalic and tapeinocephalic.

I have taken measurements, descriptions, and photographs of a considerable number of ancient and mediæval Irish crania, but many more skulls will be required to be studied before it will be possible to speak with any degree of certainty on Irish craniology. In the meantime I venture to publish this find as it has some interest, and will compare this cranium with one or two of the skulls that have passed through my hands.

The classical prehistoric Irish crania are the Phœnix Park specimens found in cists in Phœnix Park, Dublin, a little over half a century ago. Two of these are in the Academy's Collection in the Science and Art Museum, and I take this opportunity of thanking the Council of the Academy for permission to measure the skulls in that collection, the more important indices of these crania will be found in the following table. Casts of these skulls are in the Grattan Collection now in the Museum of the Belfast Natural History and Philosophical Society.[1] It will be observed that they form a fairly continuous series, to which I have added a skull, collected by the late Mr. Bell in the county Tyrone, which carries the series a step further. This skull is also represented by a cast in the Grattan Collection. Unfortunately, I have not had access to the original specimen of this skull, or of Phœnix Park No. 3, but as the indices I calculated from measurements made on the casts of the Phœnix Park crania agreed very closely with those made on the skulls themselves, we may safely regard the indices of these two crania as correct. The detailed measurements of all these crania will be given in the memoir on Irish Craniology which I am preparing.

Phœnix Park Crania.

A.—*Kistvaen in Tumulus of Knock-Maraidhe, Phœnix Park, Dublin.*

No. 1.—*Cranium of an adult male.* The glabella and supra-ciliary ridges are very prominent; there is a slight sagittal keel immediately above the ophryon, which disappears between the fairly prominent frontal eminences. The vertex is somewhat flattened; there is a

[1] Cf. Proc. Roy. Irish Acad. (3), II., 1893, p. 760.

very slight anterior sagittal keel, but between the prominent parietal eminences there is a sagittal groove; the cranial walls are flat. There is a slight bulging of the occipital squame; the occipital muscular impressions are strong. The mastoids are large. The coronal and sagittal sutures are nearly obliterated; the lambdoid is complex. There are no wormian bones. The pterion is in H (right, 16·5 mm.; left, 16 mm.).

The cheek-bones are not specially prominent; the nose is prominent, and the nasal bones are well formed and not constricted; the apertura pyriformis has slight pre-nasal fossæ; the palate is large and broad.

Norma verticalis.—The cranium may be placed in the sphenoides stenometropus group of Sergi; that is, the biparietal enlargement is far back, and there is a gradual and sensible reduction in width anteriorly; the sides of the cranium are flattened; the occipital is rounded; the skull is slightly phænozygous. *Norma lateralis.*—In a side view, the cranium appears long and depressed, with a slight occipital bulging; it appears to me to be intermediate between Sergi's platycephalus and ellipsoides depressus. *Norma occipitalis.*—The sides and base are flat, and together form a transversely-elongated oblong with a fairly well-rounded top.

The cranium is dolichocephalic, tapeinocephalic, very orthognathic, very leptoprosopic, very leptorhine, very microseme, especially in the right orbit; the naso-malar index is prosopic; and the palate is brachyuranic.

No. 2.—*Cranium of an adult male.*—The glabella and supra-ciliary ridges are more prominent than in the preceding skull; there is a sagittal keel which extends from the glabella to the anterior third of the parietals; the frontal eminences are moderately prominent; there is a slight depression at the obelion between the prominent parietal eminences; the sides of the skull are ill-filled. The cranium is flattened posteriorly about the lambda, but there is a slight occipital bulging; the inion and the muscular impressions are prominent. The mastoids are large; the sagittal suture is largely obliterated, the sutures are complex. Pterion in H (right, 13 mm., left, 14 mm.); no wormian bones.

The face is fairly broad, with wide and fairly prominent cheek bones, and a strong concave nose, the nasal bones are not pinched, the apertura pyriformis has slight prenasal fossæ, the palate is horseshoe shaped.

Norma verticalis.—This is an elongated, somewhat oval cranium, but enlarged in the region of the parietal eminences, and may be

placed amongst Sergi's sphenoides. The skull is slightly phænozygous. *Norma lateralis.*—Very similar to the last, but less depressed. *Norma occipitalis.*—Is distinctly pentagonal.

The cranium is mesaticephalic, metriocephalic, orthognathic, barely leptoprosopic, mesorhine, very microseme, prosopic and brachy-uranic.

These skulls were carefully described, and the circumstances of the find narrated by Barnard Davis, and Thurnam in "Crania Britannica" (II. 1857, No. 22 A and B). The circumstances of the find were compiled from the report of the excavation published in the Proceedings of the Royal Irish Academy, 1838, vol. i., pp. 187, 196, and from the account given by Sir William Wilde in the "Catalogue of the Museum of the Royal Irish Academy," 1857, p. 180. Sir W. Wilde had previously made some observations on the two skulls found in this kistvaen, in his "Lecture on the Ethnology of the Ancient Irish" (1844, p. 11), reprinted as Chap. IX. of his "The Beauties of the Boyne and Blackwater" (1849), p. 212. Dr. Pritchard has also described these skulls ("Researches," 1841, vol. iii., p. 200).

In this kistvaen "two perfect male human skeletons were found, and also the tops of the femora of another, and a single bone of an animal, supposed to be that of a dog. The heads of the skeletons rested to the north, and, as the enclosure is not of sufficient extent to have permitted the bodies to lie at full length, they must have been bent at the vertebræ or at the lower joints." (Proceedings, Royal Irish Academy, I. p. 189).

B.—Cist in the Phœnix Park, Dublin.

No. 3. *Cranium of an adult male.*—The glabella and supra-ciliary ridges are very strong, the ophryon is depressed, low, somewhat narrow, retreating forehead; the side walls of the frontal are ill-filled. There is a slight anterior sagittal keel; the obelion is flat or somewhat depressed; the parietal eminences are prominent, but anteriorly the sides of the cranium are ill-filled. There is a slight occipital protuberance; the muscular impressions are not well marked; mastoids large; the squamosals are rather prominent. The prominent cheek-bones give the face a broader appearance than it has; the teeth project, and there is a subnasal prognathism. The powerful lower jaw has a very prominent chin. The cranium is somewhat high in the mid-parietal region; the posterior parietal region is decidedly vertical; the skull is phænozygous.

The cranium is mesaticephalic, akrocephalic, orthognathic, probably leptoprosopic, very leptorhine, very microseme, and mesopic.

Norma verticalis.—This skull most nearly resembles Sergi's sphenoides rotundus, that is, it is wider than the more typical sphenoides, and has the elevations rounded off, especially in the occipital part, which is globular; it is phænozygous.

Norma lateralis.—In the side view the skull agrees with Sergi's sphenoides latus,[1] except that in the Irish specimen the forehead is more retreating and the superciliary arches more prominent.

The following taken from the "Crania Britannica" (II. 1865, No. 55) is the only record I can discover of this find:—"About the year 1840 a small cist was opened at a depth of 4 feet in the Phœnix Park, not far from the two cromlechs previously discovered there. It was of a domed shape, and constructed of small stones, closed at the top with a larger one. It contained a skeleton, the major part of which was placed at the bottom of the cist, with the long bones crossed and the calvarium at the top, the lower jaw upon it. This skull was presented to the Museum of Trinity College by the late Dr. Robert Ball."

ANCIENT CRANIUM FROM COUNTY TYRONE.

In the Grattan Collection there is a cast of a cranium, which is labelled "No. 2.—Kistvaen, county Tyrone, Mr. Bell's Collection." Unfortunately there is no further information about this interesting specimen, which evidently belongs to a well-marked racial type.

The original was apparently perfect, except for a fracture, with an average breadth of about 60 mm., which extends from the right squamosal obliquely over the vertex to the left frontal. The glabella and supra-ciliary ridges are prominent, the forehead is high and broad, the frontal eminences are well developed, and the frontal region of the cranium is well filled both dorsally and laterally. The high curve of the frontal, as seen in the norma lateralis, is carried evenly backwards to the middle of the sagittal suture, the anterior portion of which appears to form a slight median keel; between the prominent parietal eminences there is a sagittal groove, and the obelion is flattened. The lateral parietal regions are well filled. There is a slight bulging of the occipital squame. The squamosals are swollen; the mastoids appear to be moderately large. The face has prominent cheek-bones, and appears broad, but it is really leptoprosopic. The index 57 may, however, be somewhat too high, as the bizygomatic breadth could not be actually measured; and I estimated it at 130, with a note that

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[1] "The Varieties of the Human Species" (English translation published by the Smithsonian Institution, p. 34, fig. 11).

it might somewhat exceed that figure. The skull was probably phænozygous. The palate is large and elongated.

Altogether it is a powerful, round-headed cranium, with a strongly-marked face, and belonged to an adult male.

Norma verticalis.—The nearest form to this skull that I can find in Sergi's essay on "The Varieties of the Human Species" is his platycephalus bogdanovii. It has some resemblance to the Auvergnat type. It is phænozygous.

Norma lateralis.—The side view is very similar to that of the last skull, but the forehead is a little fuller and more vertical; the vertex is more arched, and the posterior parietal region less flattened.

Norma occipitalis.—The sides and top are well rounded.

This cranium is brachycephalic, akrocephalic, probably orthognathic, leptoprosopic, markedly leptorhine, very microseme, mesopic, but bordering on prosopic, and very dolichuranic.

While it is probable that these groups are correct, it must be remembered that as the measurements of this and the preceding skull were made upon casts, none of the figures can be accepted as being perfectly accurate.

Indices.	Oldbridge.	Phœnix Pk. 1.	Phœnix Pk. 2.	Phœnix Pk. 3.	Tyrone.	Caverne de l'Homme Mort.	Guanche.
Length-breadth, . .	73·5	71·6	76·8	78·0	83·5	71·4	76·3
,, height, . . .	70·9	68·3	75·4	84·1	—	68·8	70·5
,, ,, (auricular),	63·8	63·4	67·2	67·0	72·1	—	—
Breadth-height, . . .	96·5	94·6	98·2	107·7	—	96·4	92·9
,, ,, (auricular),	86·0	88·4	87·6	85·9	86·3	—	—
Nasal, ...	—	42·1	50	39·2?	45·3	45·6	47·6
Orbital (right), . . .	—	79·5	78	68·2	75·0	80	83·6
,, (left), . . .	—	83·7	—	—	79·5	—	—
Alveolar, ...	—	94·2	96·6	92·0	—	—	94·1
,, (auricular), .	—	105·1	108·2	107·4	103·3	—	—
Naso-malar, . . .	—	111·9	112·9	109·5	109·6	—	—
Upper facial, (KOLLMANN),	—	59·4	50·2	—	57·0	—	50·2
,, ,, (VIRCHOW), .	—	85·4	77·2	73·3	74·7	—	—

The following Table gives this series in a form more easy for comparison:—

Oldbridge, .	dolicho.	tapeino.	—	—	—	—	—
Phœnix Pk. 1,	,,	,,	orthog.	leptoprosop.	leptorhine	microseme	prosopic
,, ,, 2,	mesati.	metrio.	,,	,,	mesorhine	,,	,,
,, ,, 3,	,,	akro.	,,	,,	leptorhine	,,	mesopic
Tyrone, .	brachy.	,,	,,	,,	,,	,,	,,
Homme Mort ♂	dolicho.	tapeino.	orthog.		leptorhine	microseme	—
Guanche ♂	mesati.	,,	,,	leptoprosop.	,,	,,	—

The following are the indices adopted:—"Length-breadth" of Broca; in order to equate this to the index of the "Frankfurt Agreement" it is necessary to add ·5 to the indices given, or, to be more exact, to add ·6 to the dolichocephals and ·7 to the extreme brachycephals (cf. Otto Ammon: "L'Anthropologie," VII. 1896, p. 682). The length-height is the glabello-occipital length (Broca), and the basio-bregmatic height; the height of auricular index is obtained by a modification of the Busk-craniometer, which measures the radius from the centre of the external auditory meatus to the greatest parietal height. The nasal, orbital, alveolar, and naso-malar measurements are those adopted by Flower; the auriculo-alveolar index corresponds to that of Flower, but it is taken from the ear-hole instead of from the basion. The upper facial indices are those of Kollmann and Virchow respectively. The palatal index is that of Turner.

In comparing the Oldbridge cranium with Phœnix Park No. 1, the following points of resemblance and difference may be noted.

Norma verticalis.—Both are of an elongated oval form; but the sides are flatter in No. 1, and the supra-ciliary ridges are more prominent in O. B. and the occipital bulging is larger. No. 1 is phænozygous; O. B. was apparently only very slightly so.

Norma lateralis.—The length of both is striking (194–196 mm.), but No. 1 appears flatter above. In O. B. the cranial walls are better filled, and there is a greater swelling in the roof in the parietal region; and also the parietal squame is more prominent; the supra-ciliary ridges and the parietal eminences are more prominent; the frontal

keel gives a fictitious height to the contour of the forehead when the cranium is viewed laterally.

Norma frontalis.—The forehead is narrower in No. 1, and the frontal eminences are closer together; the great size of the supraciliary ridges, and the prominence of the frontal eminences in both, result in a characteristic large depressed ophryon. Although the lower parts of the sides of the cranium in O. B. are flat, the regions just below the temporal crest are slightly swollen. In No. 1 the sides are flatter and parallel up to the crest. The sagittal keel is also much more prominent in O. B. than in No. 1.

The norma verticalis of these two crania is shown in Pl. XII., figs. 7, 8; beside them I have placed a cast of another skull, which is also in the Grattan Collection, No. 5. It is described as "Very ancient Irish, from a Railway-cutting." I have not been able to find any further information respecting it. I carefully measured the cast, and have drawn up the following indices, which must be regarded as approximate only. The maximum length was 196, and I had to estimate the breadth, which I put down as 150; this makes the index as 76. Collignon argues that a length of over 190 in the living head is characteristic of dolichocephaly, and so we may describe this skull as dolichocephalic; it is also tapeinocephalic (length-height 71, breadth-height 93·3), orthognathic (96), leptoprosopic, Virchow (82), leptorhine (44), and microseme (79). It is obvious that both the contour of the norma verticalis and the indices prove this cranium to belong to the same race as the Knockmaraidhe skull No. 1, whatever its age may happen to be.

From the foregoing descriptions and comparisons there is no doubt that these crania belong to the same people or race; and, from their similarity to one another and to other ancient skulls which I have studied, they may be regarded as very typical examples of that race as it occurred in Ireland.

When we travel further afield we find that these crania agree essentially with the Long Barrow race of Ancient Britain and with the Neolithic Dolichocephals of Western and South-Western Europe. The remains found in certain French caves present this type in its purity; as, for example, Les Baumes-Chaudes in the commune of Saint Georges de Lévejac, and L'Homme Mort in the commune of Saint Pierre de Tripiés, both in Lozère, South France. Broca described thirty-five crania from the former cave, having length-breadth indices ranging from 64·3 to 76·1, with a mean index of 72. He also studied nineteen crania from the latter cave; of these seven-

teen had indices ranging from 68·2 to 76·7, with a mean index of 72·6, but the mean index of the male crania is 71·4; the remaining two crania had indices of 78·5 and 78·8, the total index being 73·2. Philippe Salmon has recently ("Ethnologie préhistorique: Dénombrement et types des Cranes Néolithiques de la Gaule" in Revue mensuelle de l'École d'Anthropologie de Paris, 1895) published in a convenient form an enumeration of the length-breadth indices and the bibliography of all the Neolithic crania of France and its borders; and the reader is referred to this valuable Paper for further evidence respecting the distribution of these indigenous dolichocephals or "Type de Baumes-Chaudes," as he prefers to style it.

The Baumes-Chaudes tribe belonged to what is now generally called the Mediterranean Race, of which the Guanches[1] of the Canary Islands are, perhaps, the purest living representatives. I have tabulated some mean indices of these two representatives of the race, and it will be seen that they compare very closely with the two Irish crania under discussion.

The Co. Tyrone cranium is as well-marked a cranium as the other two, but clearly belonging to a very different race.

Intermediate between this and the two first are the Phœnix Park No. 2 and No. 3 crania. These appear to belong to a mixed race. The former, however, is probably a modification of the dolichocephalic group, and might be classed among them, while the latter seems to belong to the brachycephalic group. The glabello-occipital length of the former is 183 and of the latter 182 mm., while that from the Tyrone kistvaen is only 176 mm. M. Salmon has drawn attention to a similar mixture of types in France, and he has traced the racial movements that these facts indicate. Of the 688 indices that he has enumerated the preponderating indices are 73 and 74. The dolichocephals mount up to 57·7 per cent.: (it must be remembered that he classes all skulls up to 77 as dolichocephals, instead of the more usual limit of 75): the mesaticephals are 21·1 per cent.; and the brachycephals 21·2 per cent. The fact that 53 skulls have an index of 78 denotes an already pronounced mixture. The number of indices of 70 and 80 are equal (29, 30). Indices are exceptional or rare from 63 to 68 and from 85 to 97. The proportion of the two original races is as 397 is to 146; the mixed race (145) are equal in number to the brachycephals (146).

[1] Cf. an important paper, by F. C. Shrubsall, on "Crania from Teneriffe," Proc. Camb. Philosoph. Soc., IX. 1896, p. 154.

An analogous immigration of brachycephals has been proved for Ancient Britain. It is generally supposed that this people introduced bronze weapons and the "Celtic" language into our islands.

Sir William Wilde long ago pointed out ("Ethnology of the Ancient Irish," 1844) that "among the true Irish of our time distinct traces of the long-headed, dark-haired, black-visaged, swarthy aborigines, or Gothic Firbolgs, and also (for they are very numerous) the oval or globular-headed, fair-haired, light-coloured, blue or grey-eyed Celtæ or Tuatha de Danaan. But the present Irish race is very mixed. . . . Finally, we may add that there can now be little doubt that the same early race [the long-headed] inhabited, long before the date of written history, Ireland and Great Britain, Sweden, Denmark, and the north-west of Europe generally, together with the ancient Etruria, and perhaps to central parts of Germany also; at least one or two specimens of ancient crania which we examined at Halle and Berlin lead to these conclusions. We have had an opportunity of examining some skulls of the Guanches or ancient people of the Canary Archipelago, found by M. Berthelot in Teneriffe, and they presented precisely similar characters." These conclusions were arrived at by this acute observer solely by an inspection of the skulls, and the only measurements since published on the Phœnix Park crania (which formed the basis of Wilde's comparisons) are the very few in the "Crania Britannica." Till now there has been no means of verifying this hypothesis by means of modern craniological methods. Wilde had not in his time the means of discriminating between the North European dolichocephals (Teutonic or Row-Grave type), and the South European dolichocephals.

Dr. Garson who is a well-known authority on the ancient ethnology of the British Islands, says:—"Osteological remains of the Neolithic people are distributed all over Britain, from the south of England to the extreme north of Scotland. They are most numerous in the south-west of England, especially in Wilts and Gloucestershire, the part of the country occupied by the Drobuni, or Silures, at the beginning of the historic period. They have been found in considerable numbers in Yorkshire, Derbyshire, and Stafford. Huxley and Wilson have described the same race from horned cairns in Caithness, and from other places in Scotland. I have described them from Wiltshire, Yorkshire, Middlesex, and from Orkney.

There is some doubt of their having been found yet at an early period in Ireland, as Professor Macalister informs me that he has not recognised them in Ireland, where there are no long barrows. Sir

William Wilde, on the other hand, recognised Neolithic skulls from Somersetshire as identical with certain Irish skulls. Any skulls from Ireland I have seen, which have shown characters similar to the Neolithic skulls from England, are of later date, but Huxley describes them from chambered tombs, peat mosses, and river deposits of Ireland. I think we may conclude, as regards Ireland, that although it is doubtful whether the Neolithic people were there at as early a date as in Britain, they were certainly there later." (Lecture delivered at the Royal Institution, "Nature," vol. LI., Nov. 15, p. 67; Nov. 22, p. 90, 1894.)

Thanks to the researches of Sergi, and of several French anthropologists, we now know a good deal about the Mediterranean race. The indices I have given demonstrate that it extended into Ireland in Neolithic times, and the head forms of the three first skulls mentioned in this paper are common among Mediterranean people. Sergi says that the ovoides (Oldbridge) is found from Egypt to the Iberian peninsula, and that it occurred very frequently in French Neolithic interments (Solutré, Laugerie-Basse, Grenelle, l'Homme-Mort, etc.), and equally frequently in the long barrows of England. The sphenoides stenometropus (Phœnix Park, No. 1) is very common in the Mediterranean, and the same applies to the more typical sphenoides (Phœnix Park, No. 2). These Irish crania are also orthognathic, a feature which they share with the Long-barrow people of Britain; this also is very characteristic of the skulls from the Caverne de l'Homme Mort, and the existing Spanish Basques; the Guanches and the Corsicans are also extremely orthognathous. Similarly these same people are equally leptorhine (cf. table on p. 579), but, according to Shrubsall, the mean female Guanche nasal index is 41·5, the index of the Spanish Basques is 44·7. The important orbital index tells the same tale, the index of the Spanish Basques is the lowest of any living European people, but it is lower in the skulls of the Caverne de l'Homme Mort, and of the Guanche mummies. Therefore, not only do these three Irish crania belong to the Mediterranean race, but to the Iberian group or division of that race.

Among other problems of Irish ethnology to be solved by craniological study is the question whether we had representatives of the short, swarthy, black-haired, brachycephalic race of Central Europe (the "Celtæ" of Julius Cæsar, and Broca, the "Auvergnats" or "Ligurians"[1] of some authors, or the "Type de Grenelle" of P.

[1] Sergi and some other anthropologists regard the ancient Ligurians as belonging to the dolichocephalic Mediterranean race.

Salmon); as well as the tall fair, brachycephalic race that may have come from Denmark (the "Celts" of some authors, the "Turanian" of Thurnam and Rolleston, or the "Round Barrow Race" of all authors).

Personally, I am inclined to think that the Neolithic brachycephals of Central Europe did come over to the British Islands, and that traces of them are still to be seen, perhaps more frequently in Ireland than in Great Britain. If this be so, it is probably they came as a mixed people, that mixture of brachycephals and southern dolichocephals which Broca called "Celts," for it must be remembered that he regarded the Celtæ of Cæsar as a mixed people, but mainly brachycephals. The Neolithic brachycephalic immigrants into Western Europe almost certainly came from Eastern Europe, and possibly originally from Asia; it is also probable that they were primitively of the same stock as the Lapps and Finns, or rather one constituent of the latter people. It may be that the short, dark, brachycephalic element in the British Islands was largely due to the northern brachycephals who came direct from Scandinavia in the Neolithic period, or both northern and southern brachycephals may have contributed their respective shares.

It is possible that the Round Barrow race had comparatively little to say to Irish ethnology.

Postscript added in the Press.

Since this paper was read a learned and voluminous work has been published, entitled "The Dolmens of Ireland, their Distribution, Structural Characteristics and Affinities in other Countries; together with the Folk-lore attaching to them, supplemented by considerations on the Anthropology, Ethnology, and Traditions of the Irish Race," by William Copeland Borlase. In the third volume Mr. Borlase deals very fully with Irish craniology, and he connects the Knockmaraidhe dolichocephal with the Long Barrow men of Britain, and with the Caverne de l'Homme Mort in France. The mesaticephalic skull from the same tumulus is due to an admixture with this type of a brachycephalic type (p. 978). The measurements and descriptions I have given above, together with the evidence so laboriously collected by Mr. Borlase conclusively prove the existence of the Baumes-Chaudes or l'Homme-Mort race in Ireland in very early times.

EXPLANATION OF PLATE XII.

FIG. 1.—Oldbridge Cranium, norma verticalis.

FIG. 2. ,, ,, ,, lateralis (left side).

FIG. 3. ,, ,, ,, ,, (right side).

FIG. 4. ,, ,, ,, frontalis.

FIG. 5. ,, ,, ,, occipitalis.

FIG. 6.—Cast of ancient Irish skull. Railway Cutting (Grattan Collection, No. 5).

FIG. 7.—Oldbridge Cranium.

FIG. 8.—Cast of Phœnix Park Cranium, No. 1.

XXII.

ON STONE MARKINGS (SHIP - FIGURE) RECENTLY DISCOVERED AT DOWTH, IN THE COUNTY OF MEATH. BY GEORGE COFFEY.

[Read June 28, 1897.]

The carvings on the stones in the chambers of the tumulus at Dowth are rude and shallow, and may be better described as markings than carvings. They are such as could be produced by repeated blows of a rude pick, or a sharp pointed stone. In dry weather, when the surfaces of the stones present an earthy appearance, it is in many cases difficult to detect them, and at all times a side-light is necessary to bring them out. In wet weather the markings show more clearly on the moistened surfaces of the stones. I have found also that the eye soon becomes exhausted in looking for these markings, and that on repeated visits a fresh eye detects markings which had previously escaped notice.

In the autumn of 1896 I visited Dowth, in company with Mr. C. H. Oldham. In the inner chamber off the circular chamber discovered by Sir Thomas Deane in 1885, Mr. Oldham called my attention to some markings on the upper surface of the lintel stone above the entrance to this chamber. On examination I was pleased to find that they included a typical example of the ship-figure so frequently found on rock-surfaces in Sweden.

In my Paper on the Tumuli of New Grange, Dowth, and Knowth, I have illustrated several examples of ship figures from the Swedish rocks (*Trans. R. I. A.*, vol. xxx., p. 34). These I compared with somewhat similar figures on stones in a tumulus at Lockmariaker, in Brittany, and with a figure in the chamber at New Grange. From a comparison of the forms I argued that the most probable explanation of the latter was that it was a rude representation of a ship. My argument has been adopted by M. Adrian de Mortillet to explain similar figures on dolmens in Brittany, but he is of opinion that the

part of the figure which I conjectured to be a sail, represents a guerite such as appears on the triremes in the bas-reliefs of Trojan's column.[1]

The interest of the present discovery lies in the fact that we have no longer to argue from general resemblances, but have now an example which may be said to be identical with those in Sweden.

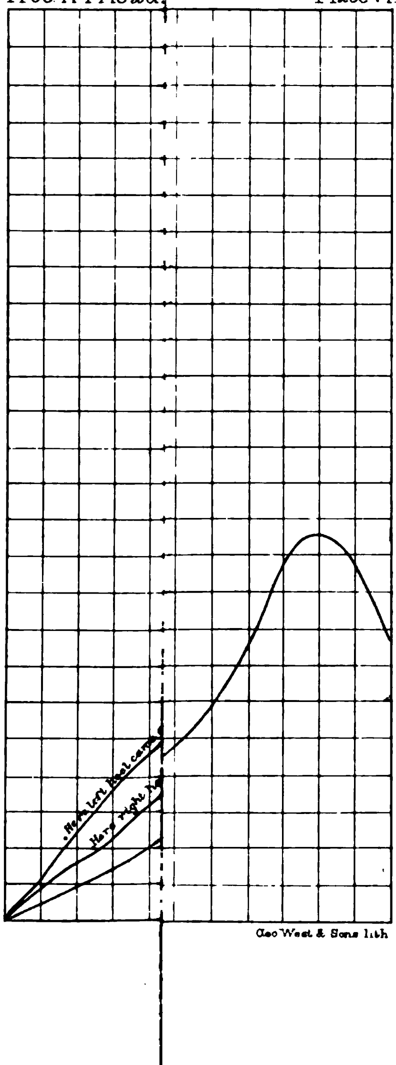
The under surface of the lintel stone on which this figure occurs is just 6 feet above the floor of the chamber. The upper surface slopes back like a desk, and it is on this surface that the markings are found. The rubbing which I exhibit (from which the accompanying

illustration, reduced to one-third, has been drawn) shows that three or four ships have been cut on this stone. There are numerous natural markings on the stone, and the artificial cuttings are in places very indistinct. It is not possible therefore to make out with certainty all the figures. Fortunately the principal boat is well marked. The cutting of this figure, as also some of the others, has been done with a pick of some sort in the manner which is characteristic of most of the cuttings in the chambers at Dowth and New Grange. The haphazard way in which the ships are placed on the stone, without order or uniformity of position, is characteristic of rock-markings in general, and in this respect does not depart from the Swedish examples. The fact that the stone is above convenient reach from the ground, as also that some of the markings

[1] *Revue Mensuelle de l'École d'Antropologie*, 1894, p. 285.

are close under the roofing stones of the chamber, seems to prove that the markings were executed before the stone was placed in position. In Sweden, ship-figures of this class are ascribed to the Bronze Age. It is possible, however, that in some instances they belong to a later period.

I take this opportunity to mention a few other markings which escaped my notice when writing on the tumuli of New Grange and Dowth. In New Grange—on the side surface of stone 12, right-hand side of the passage facing the eleventh stone on same side—are a number of triangular cuttings arranged in a sort of pattern of quartered squares, the alternate triangles of which are cut out. In the chamber, stone fig. 38 in my Paper, has some triangles cut on the under surface near the projecting edge of the stone. At Dowth, I mentioned but one inscribed stone in the circular chamber. In addition, stone number 4 from the entrance to the inner chamber, left side, has a large continuous chevron cut on it; and the left jamb of the entrance to the inner chamber has a cup and circle inscribed on it, and above this figure a rude marking of indeterminate form.



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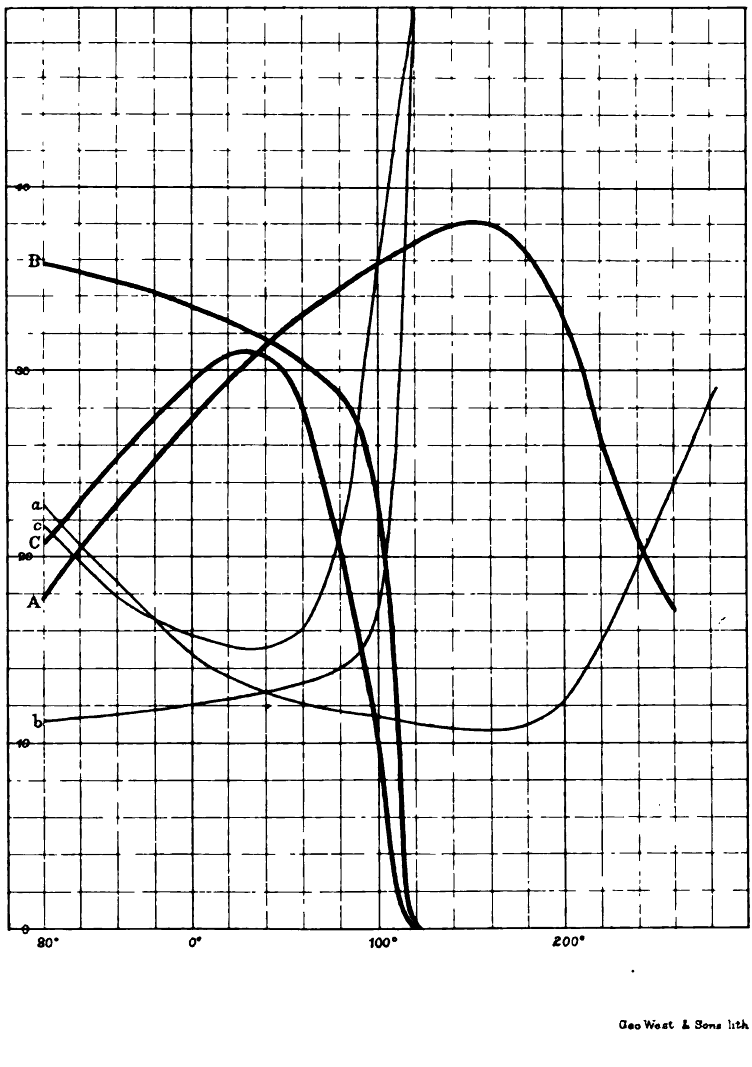

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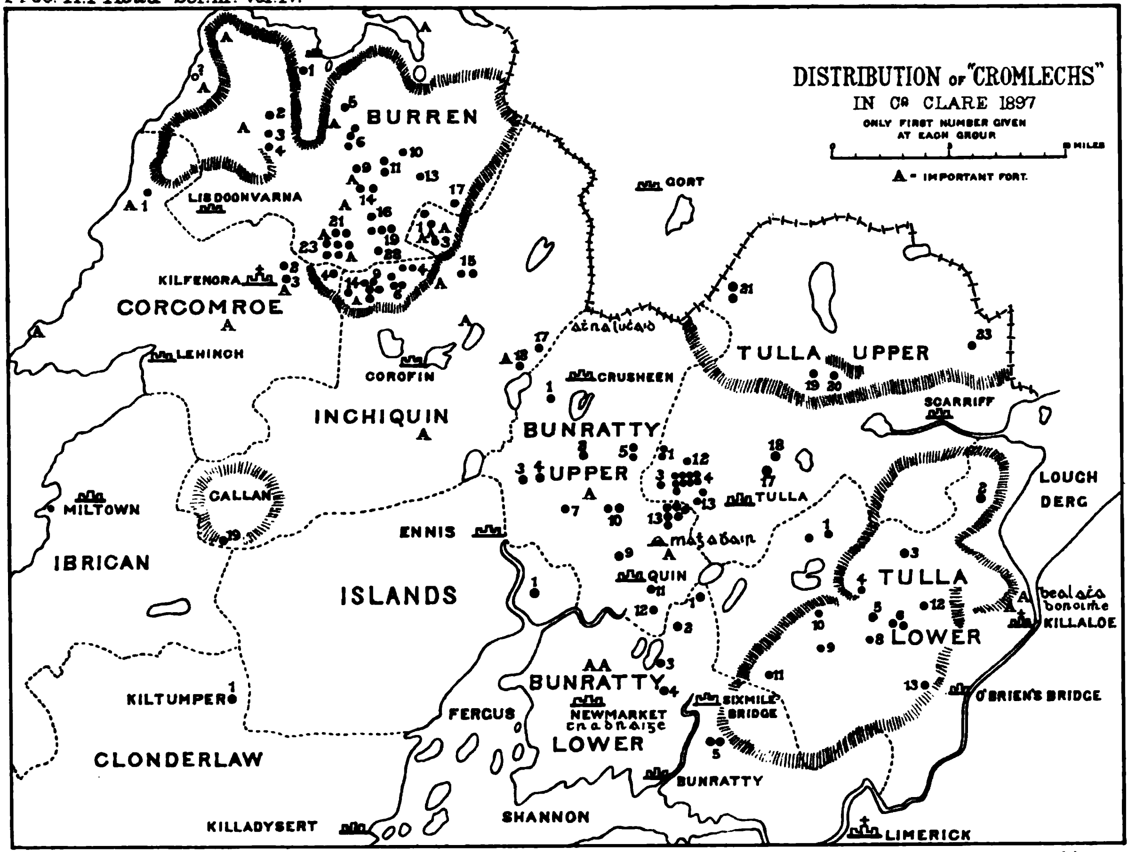

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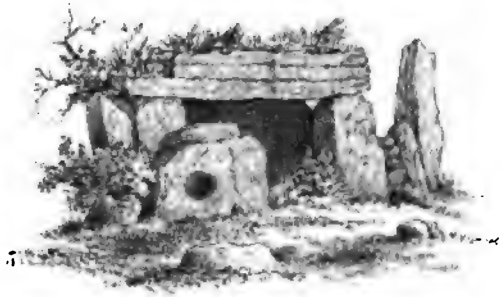

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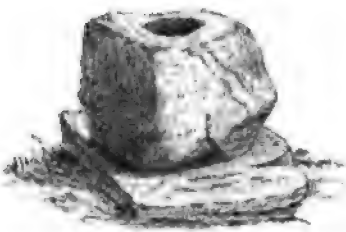

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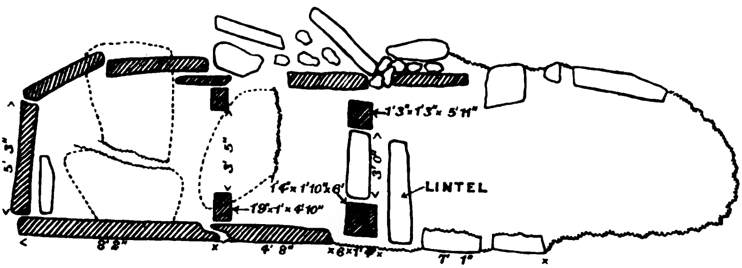

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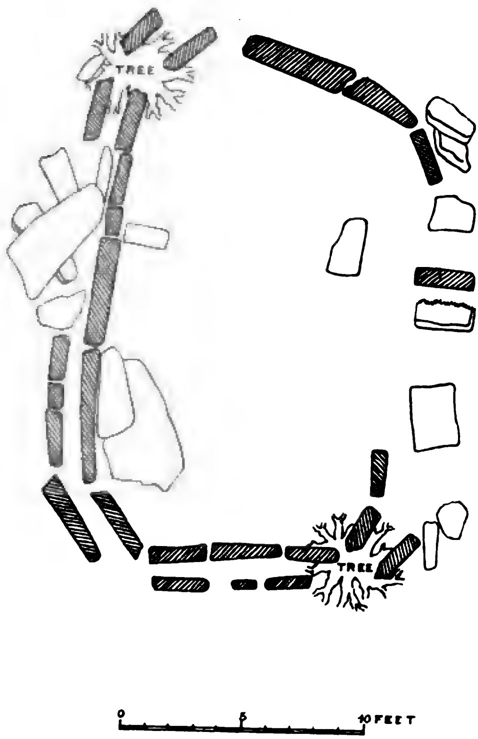

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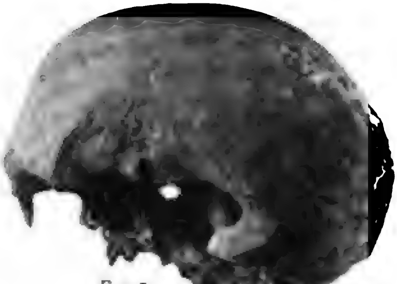

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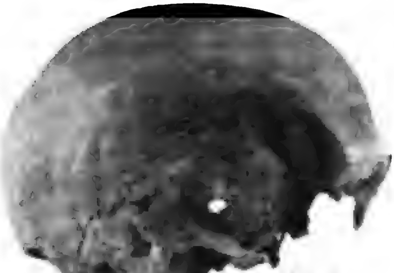

Fig 3

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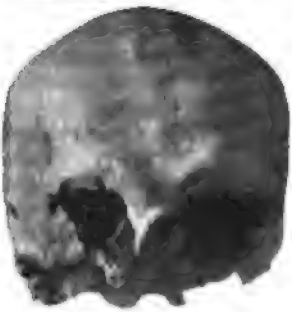
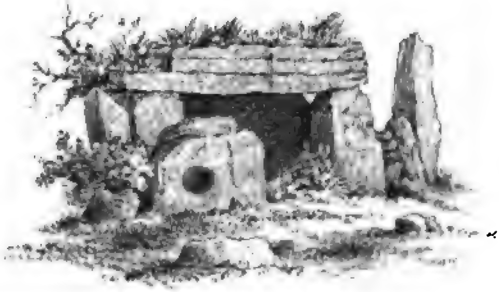


Fig 4

Fig. 6.

Fig. 7.

Fig. 8



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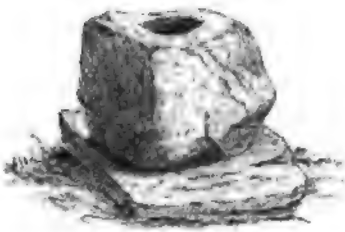

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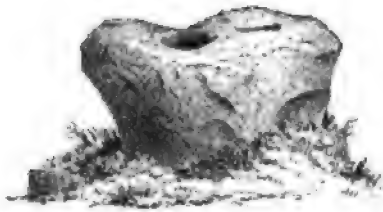

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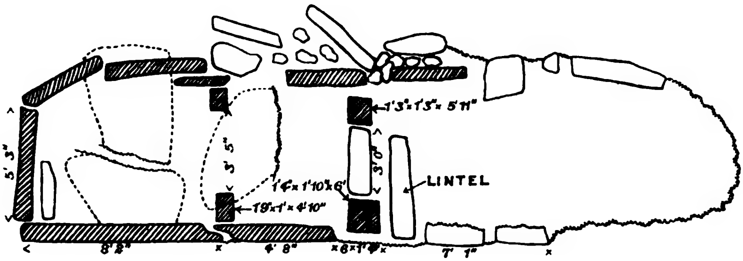

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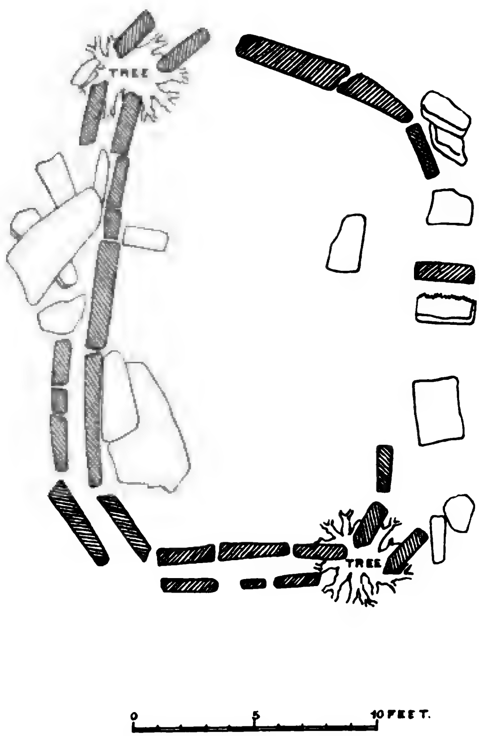

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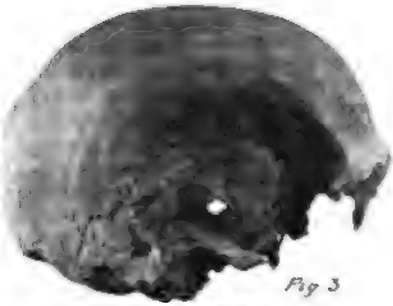

Fig 3

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Fig 5.

Fig. 6.

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Fig. 8.

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XXIII.

ON THE ORIENTATION OF SOME CROMLECHS IN THE NEIGHBOURHOOD OF DUBLIN. (PART I.) BY PROFESSOR J. P. O'REILLY, Royal College of Science, Dublin. (PLATES XIII. TO XVII.)

[Read JUNE 22, 1896.]

IN a Paper "On the orientation of certain dolmens recently discovered in Catalonia,"[1] I pointed out that these grouped themselves according to three or four principal directions, mainly, N.W. and S.E. This evidence of distinct orientation led me to presume that the cromlechs of more Western Europe would not only show distinct orientation, but might also allow of the classification of these monuments, and the formation of groups according to their observed directions, it being presumable that the same motive guides the builders in giving a like disposition as regards the cardinal points of the compass, to these monuments, in Western as in Eastern Europe.

I was therefore led to examine the cromlechs existing in the neighbourhood of Dublin from this point of view, and now submit the following remarks and drawings relative thereto as the results of my examination.

The cromlechs visited and here planned are those of Shanganagh, Brennanstown or Glen Druid and Howth.

These have already been described by Henry O'Neill, in an article published in the Transactions of the Kilkenny Archæological Society, vol. ii., 1852–3, p. 40, "On the Rock Monuments of the Co. Dublin," and also by Wakeman, in his "Handbook of Irish Antiquities," 2nd edition, 1891. Both these authors have given drawings or sketches of the monuments, but no plans. Their remarks will be cited in each particular case.

SHANGANAGH CROMLECH (Pl. XIII., figs. 1, 2).

The first examined by me was that of Shanganagh, which may be reached in or about one-quarter hour's walk from Ballybrack Railway

[1] Proc. R. I. A., 3rd Ser., vol. 3, p. 573.

Station, and is situated in a field quite close to the Bray Road, about 300 yards to the west of Loughlinstown River. The following details are from O'Neill (*loc. cit.* p. 41):—"It is within half a mile of the sea-shore. The field on which it lies is almost level; there is no trench or other artificial arrangement in connexion with it. There are only four supporting stones, two on each side; one of these has been broken in the middle, and the opposite one has fallen in; but the roof rock rests on the side of the fallen one and the top of the fragment on the opposite side, so as to be retained in its present inclined position." "The chamber lies east and west, and is 6 or 7 feet long by 2 feet 6 inches wide, and was probably 5 feet high. The floor is of clay, and at the level of the surrounding surface. The monument is of granite." Wakeman (*loc. cit.* p. 68) describes it as "a very fine specimen of what may be styled, as regards size, a cromleac of the second class. It is supported upon four stones, and presents no appearance of having been enveloped in a mound of any description. The chamber would seem to extend east and west. There is neither name nor legend in connexion with the monument. The situation is close to the sea."

I was unable to recognize the break in the stone mentioned by O'Neill, who evidently wrote under the impression that the cap-stone was originally placed horizontally, and was then "five feet high," that is, lay horizontally on the supporting stones at 5 feet above the surface of the ground. This interpretation does not seem to be borne out by the examination of the monument. There are four stones (Pl. XIII., fig. 2). On three of these the cap rests; that is, on the north-west stone, the south-east, and the south-west one. The north-east stone is not in contact with the cap, and leans against the adjacent south-east stone; its eastern face making with the adjacent face of the south-east pillar stone an angle of 60°, as indicated in the plan. The cap-stone lies fairly evenly in the north and south direction, on its supports, dipping, however, slightly to the north, owing probably to the want of support of the north-east stone. It slopes, or inclines to the west, at an angle of 23° with the horizon (taken on the under face), and I could see no indication to justify the supposition that it ever occupied the horizontal position suggested by O'Neill. It is to be noted that a hole of about three-fourths of an inch in diameter, and 5 or 6 inches in depth, has been drilled in the upper surface of the stone on the north side. Similar holes are found in the Ancient Inscribed Stone, Killiney, described by Wakeman (*loc. cit.* p. 49). The orientation of the chamber is practically east and west, that of the east side of the south-east stone

being north 1° 46′ west, or say a degree and a-half from the true north and south. Even supposing that the stone had been originally oriented true north and south, the lapse of time, with all its attendant accidents and the corrosive action of the atmosphere, would reasonably account foı the actual slight difference at present shown, the roughness of the stone surface not allowing a closer approximation of direction than a degree at best. It is remarkable that the western extremities of the north-west and south-west stones lie also in a line nearly due north and south, the difference therefrom being 1° 46′ west; how far this was originally intended can only be conjectured at present. Looking at the eastern end of the cromlech, as shown in the elevation (Plate XIII., fig. 1), it will be remarked that the south-east stone bearing the north and south face is on the left-hand side of the observer. This arrangement also presents itself in the cromlech of Brennanstown. It may not be out of place to further note that both the one and the other are situated in the vicinity of streams.

GLEN DRUID CROMLECH.

(Plates XIV., XV., XVI.).

The Brennanstown or Glen Druid cromlech is situated in a small secluded valley or glen, situated about 500 yards to the east of Carrickmines Railway-station, which is overlooked by a square tower forming a notable landmark from many points in the vicinity, and shown in Wakeman's sketch (*loc. cit.* p. 70). The monument lies at the head of the Glen to the west, and close beside a stream which seems to have been the principal agent in carving out from the granite the Glen, of which the direction in this point is nearly east and west, and presumably corresponds to a main line or lines of jointing. O'Neill, after giving the dimensions, states:—"The direction is east and west, the floor clay, and considerably lower than the surface of the field. There are several large stones lying about, and tolerably decided indications of some of them having been arranged to form two parallel lines of approach to the lower end of the monument." Wakeman calls it "a very perfect cromleac," describes it summarily, and says, "A number of detached stones lying about this very perfect example would indicate that it was originally accompanied by a circle of pillar-stones."

The section and elevations on Plates XIV., XV., and XVI. will enable a more complete and accurate estimate to be made of this very remarkable monument. The stones are all of granite, which is the rock of the Glen. They are in an excellent state of preservation, and have not seemingly suffered any serious derangement. It will be seen from the

plan (fig. 1) that the orientation of the chamber is very perfect. The difference from true bearings not being more than 1½°, or quite within the degree of accuracy of measurement, which the present states of the surfaces of the stones can allow, no matter what the care taken. The orientation east and west is true only for the northern side of the chamber, while the southern side presents quite a different direction, that of about 36° north of east, and south of west, while the two end stones closing in the west and east sides of the chamber are nearly parallel in direction, but do not lie in the north and south plane. The

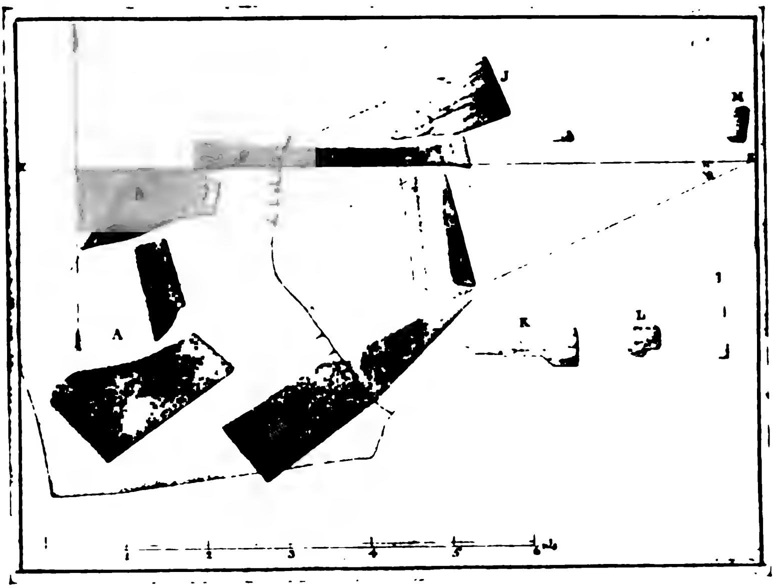

Fig. 1.—Glen Druid.

south-east stone is broken in two, and the halves have undergone a slight derangement of position. The chamber was therefore originally composed of six stones and the cap; of these four still support the latter, while the two end stones are not in contact with it.

This is shown by the western elevation of the monument (Pl. XIV.) and the interior view looking west (Pl. XV.), as also by the west and east section (Pl. XVI.). The space between the central western stone and the under surface of the cap is about 18 centimetres (= 7½ inches), and must have originally so existed. Moreover, this central stone

is gabled or mitred on its upper end, and thus bears a rough resemblance to an ordinary type of modern tombstone. The eastern end stone only reaches the level of the ground, and, as stated and shown by the section and plan, is not in contact with the cap. Outside the monument and at the eastern end of it, appear, on the surface of the ground, other stones, as marked in the plan, which show a rectangular arrangement, and seem to point to the existence of a sort of porch or other building; or, as O'Neill puts it, showing "indications of some of them having been arranged to form two parallel lines of approach to the lower end of the monument." This matter seems worthy of further investigation and comparison with monuments of a similar nature elsewhere, assuming of course that these stones are coeval with the cromlech. At the north-east end of the chamber, there is a large stone, marked J. in the plan, lying in contact with the eastern end of the northern stone. What its signification may be, I do not venture to suggest, but call attention to the direction of its northern face, which is east 24°–25° north, and west 24°–25° south; that is practically the amount of the southern declination of the Sun at the winter solstice. Moreover, it will be seen by the plan, that this is also approximatively the direction of the southern wall of the chamber. There is thus suggested a possible connexion between the direction of these stones and their utilization for the observation of the setting of the Sun at the winter solstice. In order that such observation should be possible, it were necessary that the arrangement of the chamber would not merely allow of it, but should in some way favour it. Now it can be seen that, owing to the manner in which the stones forming the western end of the chamber are disposed, the sky-line of the neighbouring western extremity of the Glen is visible from under the rim of a lower face of the cap as shown by the interior elevation of the western end of the chamber (the actual growth of timber obstructing the view on the south side). May not therefore the central mitred stone of this western end have served as an index to mark the position of the sun at the time of the winter solstice, for an observer looking from the eastern end of the chamber and sitting on, or at the level of the low stone which there closes it in. This was possible when the whole sky-line of the ridge was yet free from timber growth, what remains of it free showing this sufficiently. The direction of the Sun in the winter solstice is marked on the plan, and points to the feasibility of the suggested observation and its connexion with the central western mitred stone. There are other peculiarities connected with the stones of the southern wall of the chamber which seem

worthy of attention. Thus, it may be observed from the elevation of the north side of the cromlech, that the stones of this southern wall form at their junction or overlap a U-shaped void or opening with rounded surfaces; these are smooth and, as it were, water-worn; this result might possibly arise from a very simple and natural cause, that is, the habit of the cattle grazing about rubbing their dewlaps on these surfaces, the height of the opening and its size allowing of their doing so; nevertheless, the fact that these smooth surfaces are not continuous horizontally, but extend downwards on the faces of the stones beyond the parts of these accessible to the cattle, tends to show that originally these surfaces were smooth. Lastly, on the inside of the south-western supporting stone (C), and at a height of about 1 m. from the floor, there may be recognized, on careful examination by the hand, small patches of the surface perfectly smooth and, as it were, ground fine. One spot in particular struck me much, as it shows a cross-section of a mica crystal perfectly smooth, and such as to imply water grinding, say with fine sand, on a hard, smooth surface, the result being therefore quite distinct from any possible result of weathering. These patches I look on as the remains of a polished glaciated surface, and am led to conclude that the stone in its original state was a glacial boulder, highly ground and polished on one face at least, probably having been found in the neighbouring stream, and was used by the builders of the cromlech preeisely on account of its highly polished surface, to which some particular signification was attached. If my observations and conclusions are correct, some very interesting points of view would thus be opened up both as to the choice of the material used in these monuments, and as to their age, since the lapse of time necessary to allow of the removal by atmospheric action of the polished surface has been in some way proportional to their age. There is also thus raised the question, were not the other stones of the chamber polished boulders, including the cap itself? This would be at least probable. The cap is undoubtedly a glacial boulder, and may have been more or less polished on its under surface. As to the other stones, no trace apparently remains of any former smooth surface. However, the northern stone (F) presents a character which merits attention; it is its relative thinness and extent. Stones of granite which have undergone very great pressures by superimposed matter, and were subjected at the same time to motion in a given direction, as also to low temperature with water present would undergo, at least in the portions near the contact surface, molecular derangements such that subsequent relief of the pressures and low temperatures would

give rise to a tendency to expansion and a subsequent scaling off of flat flakes, leaving behind a rough, slightly undulated surface, such as is presented by this northern stone.

From this point of view I am inclined to think that it may have been a glaciated plate of granite, smooth at least on one side, and used on that account. In close proximity to these smooth patches on this south-western stone occurs an incision about 10 c.m. long, by 1½ c.m. broad, and ½ c.m. deep, which may have been done by hand, but which might really be likewise the result of contact with a hard angle of a rock under glacial or erosive action, but it is difficult to determine to which cause it may have been due.

The cap is a very remarkable mass of granite in size, and presents an inclination to the horizon of about 14°. The under surface is singularly even and very slightly arched. The cap is shown in horizontal projection on the plan, and also in the western and northern elevations in the Plates. What is of very great interest is the channel cut across the upper face in the form of a bow, as shown on the plan, and bearing two sets of incisions—one on the north side, the other on the south. These part from the channel, and extend about 6 to 10 cm. up the slope of the face or towards the western end of the stone. Both the channel and the incisions have suffered from atmospheric action, and have therefore lost somewhat of their original sharpness of outline; nevertheless, they are still perfectly distinct, and the intervals between the incisions have been measured as carefully as the state of the surfaces allows. They are as follows:—

	mm.	mm.	mm.	mm.	mm.
South side, .	142,	154·5,	278·5,	233·5	—
North side, .	221·5,	162·5,	91·5,	159·5,	127·5

The measures marked on the plan are c.m., and are only approximative. There are twelve incisions in all. One on the south side is, however, so elementary or effaced as to be doubtful. The intervals are given not merely as belonging to the plan, but also because they may represent some unit of measurement. I do not attempt to speculate on their use further than to suggest that, if there be admitted evidence of the utilization of the monument for solar observations, these incisions may really have had the same object, and might have been in connexion with a gnomon of which the place would have been at some point to the east; possibly among the stones shown on that side of the chamber in the plan.

Howth Cromlech.

(Plate XVII.)

The last cromlech examined was that of Howth Demesne, which, probably on account of its having been more accessible than those already described, has suffered demolition to an extent which is practically complete. Its plan, therefore, can only present the relative positions of the stones which formerly supported the cap in their actual state. The extent of the derangement they have undergone can only be guessed at; however, the three stones forming the south-east extremity are nearly in their original positions, and these furnish some very interesting points of comparison as regards the Brennanstown cromlech. Of the Howth one, O'Neill says:—"An attentive examination of this monument has convinced me that this enormous mass (the cap stone) constituted the roof of a chamber lying east by north, the chamber being about 12 feet long by 4 feet wide, the floor of clay, the walls of other great stones, three at each side and one at each end—eight in all. The roof rock, though very irregular on its upper surface, is tolerably level beneath, and was so situated as to have the upper surface horizontal, or nearly so, thus constituting a level ceiling to the chamber; but, owing to the great thickness and consequent weight at one end, the supporting stones have given way, and, in slipping, the roof rock has been caught by a part of the stone on which its present higher portion rests. The supporting stones from which it has slipped are still standing undisturbed, and are seen on the left hand side in the accompanying sketch. They are about 7 feet high, so that the original height of the monument must have been 12 or 13 feet. The longer direction of the chamber is east by north; its floor is a little below the natural level of the soil. There are several rocky fragments lying around, which, in one part, form a sort of rude intrenchment of the monument; but whether artificial or the result of accident I could not decide. The monument is of quartz rock" (*loc. cit.* p. 41).

Wakeman says:—"This fine monument is situated near the base of an inland cliff within the grounds of Howth Castle, and at a distance of about three-quarters of a mile from the seashore. It consists at present of ten blocks of quartz, of which the table or covering stone, the largest, measures from north to south 18, and from east to west 19½ feet, the extreme thickness being 8 feet. The weight of this mass has been computed at ninety tons. Such an enormous pressure

appears to have caused the supporters, more or less, to give way; they all incline eastward, and the table would seem to have slipped

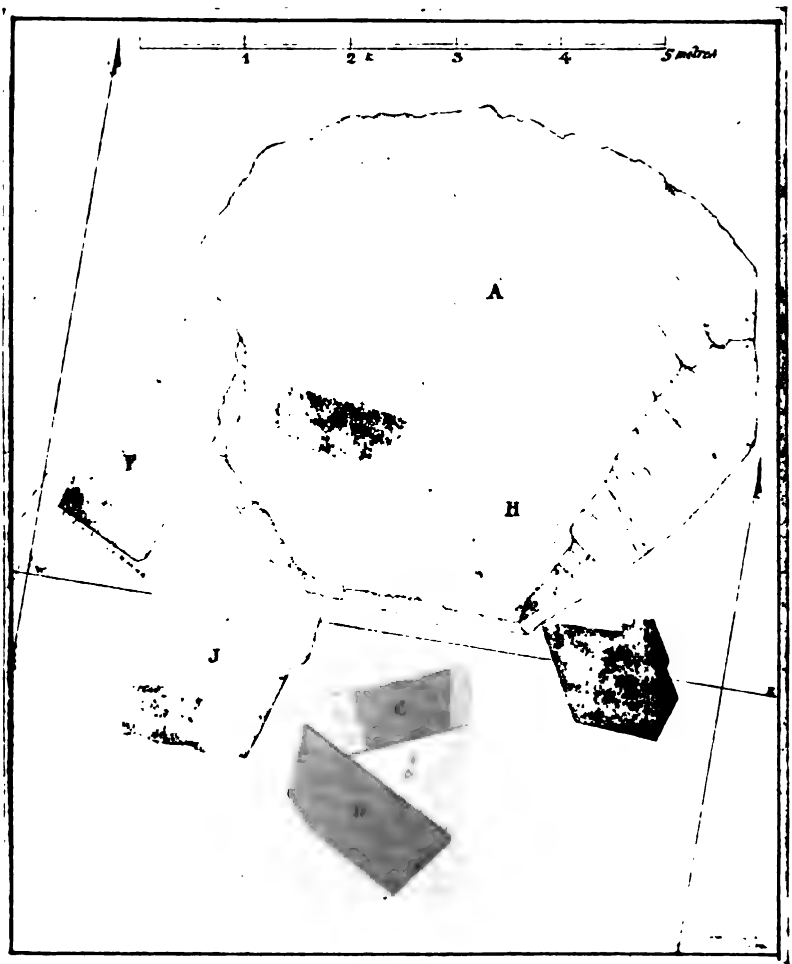

FIG. 2.

in that direction, in its course breaking one of the pillars in two. It did not come to the ground, however, having been arrested in its descent by the undisturbed stump of the fractured stone, upon

which, in an inclined position, it now reposes at its lowest end. The supporters are about 6½ feet in height; so that, as Beranger, who visited and described the remains about one hundred years ago, states:—'This, one of the grandest mausoleums, must have made a noble figure standing, as the tallest man might stand and walk under it at ease.' The work on the interior would seem to have constituted an irregular chamber, tending east and west; but much disturbance of the stones has occurred." "These stones were formerly called Fin Mac Coul's Quoits" (*loc. cit.* p. 64).

The divergence of views shown by these authors, as regards the direction of the chamber, justifies the making of a correct plan (see fig. 2, p. 597). I only noticed seven stones and the cap. Of these the three south-eastern ones are erect, and practically in their original positions; the most north-easterly (B) of these three, which was one of the props of the cap stone, has remained in contact with it, but has been dragged considerably from its original upright position. The other stones (F, G, H, J) have been more or less completely overturned, those to the north now lying nearly flat on the ground. There can, therefore, be only a presumption as to the exact positions they occupied when originally upright; and, accordingly, I have indicated their presumed original positions, taking for granted that, in their motion on being overturned, they yielded along their longest dimension as axis; but some of them may have undergone a twist at the same time owing to the greater or less depths of their buried extremities and the positions of the points of bearing of the cap. One of the stones has been broken clean across, and seemingly indicates thus the direction of the thrust, that is practically north by east. Comparing now the stones of the south-eastern end still upright, and shown in the elevation of that extremity of the monument (Pl. XVII.) (which was evidently the highest) with the similar stones of the Brennanstown cromlech, it will be at once observed that the same relation of these stones, one to the other, exists; that is, between two taller supporting stones, is found a third stone not so tall, and therefore not having been in contact with the cap stone by a certain interval; moreover, this central stone is mitred and closely applied to the supporting stone on the left hand.

There is evidently here an intentionally similar arrangement to that shown by the Brennanstown cromlech; this becomes all the more evident when the material of the stones is considered, which at Howth is quartzite from the neighbouring cliff, full of quartz veins, and therefore an extremely hard rock most difficult, in any way, to

fashion into shape. That the middle stone was roughly fashioned seems to me quite evident. As in the case of the Brennanstown monument, these two stones (the left-hand one and the mitred) are closely approximated. If therefore it be assumed that in this latter case the mitred stone was intended to help in an astronomical observation it should follow by analogy that in the Howth monument some such object was sought. As a matter of fact it is found that on standing on the inside or chamber side of the mitred stone, and looking over it towards the quartzite cliff ("Much Hill"), the sky-line of this stands out clearly, and the view of the sky in that direction is open. This peculiar relation, one to the other, of these three end stones seems to connect these two monuments; but was that of Howth intended in this respect for solar or stellar observation? This question is to some extent answered by pointing out that the left-hand stone (D) or most south-westerly has a direction east 27° 45′ south, and west 27° 45′ north, or roughly is in the direction of the summer setting Sun at the period of solstice. It is quite true that the present value of the declination is only 23° 27′, but it is recorded by Bailly, in his "Histoire de l'Astronomie," that higher values were used amongst the ancients. At present owing to the dismantled state of the monument this application of it is not at all evident, but when the supporting stones were all upright and in their original positions, the rays of the setting Sun at the period of the summer solstice, could traverse the chamber and pass out between the mitred stone and the adjacent south-western pillar, it being borne in mind that the monument stands at a level so as to dominate the horizon to the west, and not taking into account the present tree growth which of course now interrupts the clear view in that direction. Judging from the nature of the contact now existing between what I may call the middle-stone on the south-west side of the chamber (J.), and the under surface of the cap, I am inclined to believe that this stone has been twisted in its fall towards the north, and that originally it stood in about the same direction as the south-western pillar-stone, and did not obstruct the passage of any light coming from the north-western end of the chamber, as its presumed position would apparently indicate.

In any case it will not be forcing the data presented by the plan to say that the original direction of the chamber was about west 26°–27° south, and east 26°–27°. Lastly, there is a singular similarity in the relations of the left-hand stones of the Shanganagh and Howth cromlechs with the adjacent stones in that they make at their contact nearly equal horizontal angles, that is, about 55° to 60°.

XXIV.

ON THE ORIENTATION OF SOME CROMLECHS IN THE NEIGHBOURHOOD OF DUBLIN. (PART II.) BY PROFESSOR J. P. O'REILLY, Royal College of Science, Dublin. (PLATES XVIII. TO XX.)

[READ NOVEMBER 30, 1896.]

IN the previous Paper I point out that the Cromlechs of Glen Druid, Shanganagh, and Howth showed distinct evidence of orientation, and that in the case of the first-mentioned, the arrangement of the stones forming the north, south, and west walls of the chamber, seemed to admit of the opinion that the monument had served for the observation of the summer solstice. Encouraged by these results, I was led to examine and make plans and sections of the other cromleachs which exist in the neighbourhood of Dublin; and during the summer months just past was practically able to complete this work.

I have now to submit the plans of the Cromlechs of Mount Venus, Larch Hill, and Shankill, with a description of two of the stones forming part of the group known as "Druid's Chair," Killiney, as they seemed to me to bear on the general question of the orientation of this class of monument.

MOUNT VENUS CROMLECH.

(Pl. XVIII.)

A sketch of the Mount Venus cromlech is given in Plate XVIII. It is mentioned by O'Neill ("Trans. Kilkenny Archæological Soc.," vol. ii., 1852–3, p. 42). Having given the dimensions of the principal stones, he states:—"The floor is of clay, and a foot below the surface level, to which height its sides are faced with small stones without mortar." These facings no longer exist. The supporting pillar, according to O'Neill, must have been higher, "as it is evidently broken at the top." This seems to be an error, as all the similar pillar-stones of the other cromlechs observed, are pointed, and

seem to have been purposely so selected or fashioned, as to present that form. He estimates the probable weight of the covering stone at about seventy tons, and discusses the probable original form of the monument, and gives a restoration of it in accordance with his views. As to the stones mentioned by him as lying about, and still existing, and which he suggests may have formed part of the monument, such as he supposes it to have been, I have shown them on

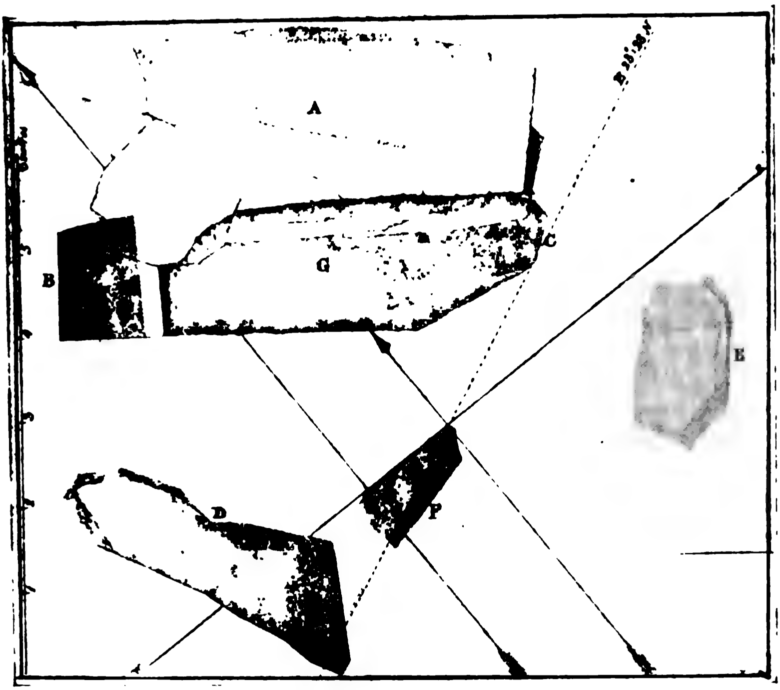

FIG. 1.—Mount Venus.

the plan (fig. 1), and call attention to their forms, which are remarkable in many respects. The largest stone to the west is really a very fine monolith (D), having an approximate weight of about seven tons, and an extreme length of 4 m. 40. The edges of its western end have evidently been fashioned by hammering or chipping so as to give to this extremity a pointed or mitred form, as in the case of certain of the pillar-stones of Glen Druid and Howth cromlechs. The most easterly

stone (E), relatively small in size, presents the same fashioned and mitred extremity. The stone situated between these two (F), though still smaller in size, presents characteristics which render it very interesting. Its edges are relatively sharp, and the stone is so disposed that one of the faces, the northern one, gives a due east and west direction within a degree of error. Its form presents the further singularity, and is such, that an edge on the upper surface furnishes a direction, as shown on the plan, looking to the winter solstice, that is west 23° 28′ south. This direction would, in the east, give the rising of the summer sun at the solstice. Now it is interesting to remark that the position of the cromlech is at such a height above the sea level, and the slope towards the sea such, as to afford a clear view on the horizon of Dublin Bay, a condition favourable to an exact observation of this nature.

It may be suggested that the eastern and western stones already mentioned were formerly set up where they now are, so as to give with the face or edge of this remarkable stone, east and west points of bearing that is to mark out more distinctly the required directions. Considering the weight of the larger of these stones (7 tons), I certainly have doubts as to their having ever formed supports for the cap stone The orientation of the bed of the cromlech is roughly north-west and south-east.

Druid's Chair, Killiney.

As bearing on the orientation of the stone just described, I submit a plan of two of the stones forming the group known as the "Druid's Chair," Killiney. One of these, the most westerly of the set, presents on its southern face two deep circular incisions which have suggested that they were made with a view of obtaining two millstones from this rock. Its upper edge or face is partly fashioned into two circular surfaces, so that the north-eastern side of the rock presents the outline shown in the accompanying elevation. Between this rock and the "Druid's Chair" lies a single stone somewhat disposed as that just described for the Mount Venus cromlech, and so markedly oriented east and west. At the Druid's Chair the stone in question has a face practically due north and south (north, 0° 35′ west). There exists thus a due north and south line of direction, and it was to be presumed that means had been secured of determining an east and west line of direction. Now, as a matter of fact, a line drawn from the southern corner of this stone to the south-western corner of the mill-stone rock, gives a due east and west direction.

It would seem therefore that, independently of the direction of the principal parts of these monuments, a means of orientation was attained by the builders or users of them by fixing single stones, either due east and west or north and south, and placing these in relation to other parts of the monument, so that a corresponding north and south or east and west line of direction was determined. As in some way agreeing with this view is the fact that the east and west line determined as mentioned and indicated in the plan is that of the entrance to the present enclosure of the monument, which was formerly surrounded, according to tradition, by a ring of stones with an entrance way, which in all probability, if not certainly, is that still existing.

Shankill Cromlech.

(Pl. XIX., figs. 1 & 2.)

The Shankill cromlech is situated in a field to the south of Carriggollaghan, near where the old road from the quarries attains its highest level. It differs from all the others about Dublin in being built of smaller stones, which have evidently been taken from the neighbouring quartzite beds of Carriggollaghan. Five stones remain *in situ*, four of them forming the walls of the chamber, and the fifth forming the covering stones, as shown in the accompanying plan and elevation (Plate XIX.). In this case the orientation is practically due east and west, and the position of the monument such that the chamber would receive the rays of the rising sun at equinox, and would allow of the observation of its period. It may have been intended also to allow of the observation of the solstices; but, as the monument is evidently incomplete, it is unnecessary to examine it from this point of view, although the fact that the diagonals of the chamber in its present state make, with the east-west direction of the sides, angles which approximate to 23° 28′ (as would be required for that purpose) is very suggestive. The situation of the cromlech is very commanding, and the view embraces a large extent of horizon.

Larch Hill Cromlech.

(Pl. XX., figs. 1 & 2.)

The Larch Hill cromlech is situated in a field lying to the west of and below the level of the old road, which, parting from Whitechurch bridge, leads up to Kilmashogue mountain and along its side.

It is so enclosed by trees that it is screened from the observation of the passer-by, and would thus escape notice. It consists of a principal upright stone (D)—a very remarkable monolith; of a side stone (C), evidently the northern wall of the former chamber; and of a certain number of other stones, the two principal of which (A, B) represent the covering stone and what was, probably, a south wall stone of the former chamber. Both of those stones are no longer in their normal positions, and present themselves one overlying the other, as shown in

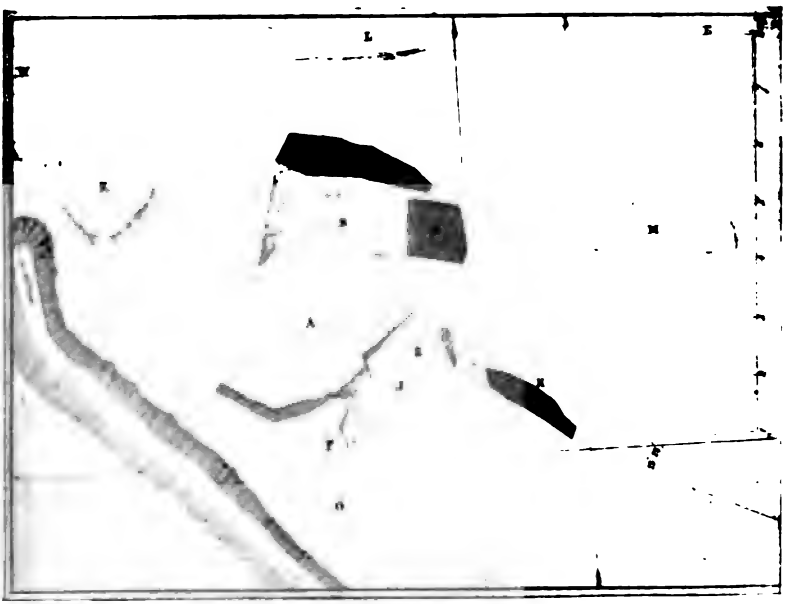

Fig. 2.—Larch Hill.

the plan and in the elevation (Pl. XX.). There are eight stones outlying, and so disposed as to allow of their being referred to the four cardinal points. The east side of the upright pillar stone (D) is practically north and south (N. 2° 15′ W); while the western edge of the most eastern stone (M) is still nearer due north and south (N. 0° 45′ E.). The upper edge or arras of the most northern stone (L) is due east and west, while the south-west edges of the covering stone and the stone underneath it (B), and the edge of a stone (J) which projects eastward from underneath the covering stone at the level of the

ground, all lie in the direction of the summer solstice—that is, nearly N. 66° 32′ W. It may therefore be said that the direction of the chamber was intended to be in this direction. Within a few feet of the cromlech a spring, which evidently issues from a joint in the granite, runs for a short distance and disappears in the ground again. The fact is worth citing, as other of the cromleachs examined were situated near streams, as notably in the case of Mount Druid.

The results presented by the examination of the six cromlechs, of which plans and sections have been submitted, seems to justify the opinion that due orientation was a condition observed by the builders of these monuments, and that thus they are connected with the ancient temples and structures similarly characterised. They merit, therefore, careful observation and recording, as involving characteristics which may assist in the ultimate determination of the period to which they belong, and the race or races to whom they owe their origin.

XXV.

REPORT ON THE MUSCI AND HEPATICÆ OF THE COUNTY CAVAN. BY DAVID M'ARDLE. (PLATES XXI., XXII.)

(COMMUNICATED BY FREDERICK WILLIAM MOORE.)

[Read JANUARY 10, 1898.]

HEREWITH I beg to submit to the Royal Irish Academy, on behalf of their Irish Flora and Fauna Committee, the result of a botanical excursion to the county Cavan, which extended from the 7th to the 11th October, 1893.

The first day was spent on Slieve Glah, a small mountain on the N.E. side of the town, from which it is about four miles distant. It gradually elevates to 1057 feet. I also dredged the adjacent lakes.

The most conspicuous plant on the mountain was *Lycopodium clavatum*, which grows in some quantity near the summit, trailing over the bare peat, to which it was fixed by remarkably strong flagelliform roots. Though this plant is included in district 10 of the "Cybele Hibernica," there is no locality named for the county Cavan. Some interesting mosses and liverworts were also collected. The season for flowering plants was over, but I gathered *Achillea Ptarmica*, which grows sparingly on the mountain with *Crepis virens* and *Hieracium pilosella*; and *Polygonum persicaria*, by the roadside, as I ascended, still continued in bloom. Some good collecting was done on the shores and in the plantations about Lough Cultra. The water-plants were mostly decayed, and the dredge only brought their remains and *Juncus supinus* which was floating in the lough. In bogholes near the town, *Potamogeton pusillus* was plentiful. This is an addition to district 10 in the "Cybele Hibernica."

I spent a day collecting about the shores and woods of Lough Oughter; one of a chain of lakes which occupy a considerable portion of the centre of the county. It is a very picturesque district, and only wants mountains to complete the beauty of the scenery. The lakes slope gradually from the shore, margined with *Phragmitis communis* and *Equisetum palustre*; and on the eastern side, backed

up with stately specimens of the white spruce, *Abies alba*, of huge dimensions, several species of oak, *Pirus Aucuparia*, Chestnuts, and enormous specimens of Beech. These were in full foliage, which was coloured with the charming tints of autumn. The most interesting find amongst flowering plants was *Sagina nodosa*, which grows sparingly by the margins of the lakes, and has not been previously reported from the county Cavan. The most successful day's collecting was done along the banks of the Analee river. From Ballyhaise bridge I followed its course for a considerable distance, and from its banks crossed into the oak wood, where I gathered, in some quantity, *Scapania aspera*, which grows plentifully amongst the limestone rocks, and is an addition to the list of Irish Hepaticæ. The collection made in the Farnham demesne was also interesting, on account of the occurrence there of the curious *Metzgeria conjugata* in a fertile state. The plant is unique amongst all the other species in the genus, in having a monœcious inflorescence, which character is well shown in Plate XXII., so excellently delineated by Mr. Allen.

The total number collected is of Musci forty-one species, and of Hepaticæ thirty-nine. The occurrence of *Radula voluta* and *Riccardia palmata* so far northward is remarkable.

My best thanks are due to M. B. Slater, Esq., of Malton, Yorkshire, whom I consulted on critical species, and to W. N. Allen, Esq., for the drawings of the two plates. It would have been impossible for me to be able to furnish these extended lists were it not for the kindness of the late W. Humphreys, Esq., J.P., of Ballyhaise House, who freely granted me permission to collect in his demesne.

MUSCI.

Sub-Order I.—Sphagnaceæ.

1. *Sphagnum acutifolium*, Ehrh. Slieve Glah.
   Sphagnum acutifolium, Ehrh., *var. rubellum*, Wils. Slieve Glah.
2. *Sphagnum cuspidatum*, Ehrh., *var. plumosum*, Nees. Wet places, Slieve Glah; often found floating.
3. *Sphagnum papillosum*, Lindb. Killakeen, sparingly.

II.—Polytrichaceæ.

4. *Catharinea undulata*, Web. et Mohr. Slieve Glah.
5. *Polytrichum aloides*, Hedwig, = *Pogonatum aloides*, P. Beauv. Peaty banks, Killakeen.

III.—Dicranaceæ.

6. *Ceratodon purpureus*, Bridel. Bank on the shores of Lough Cultra, plentiful, Slieve Glah.
7. *Dicranella heteromalla*, Schimp. Killakeen, common.
8. *Dicranella varia*, Schimp. Peaty banks, Killakeen.
9. *Dicranum majus*, Turner. Ballyhaise woods, common.
10. *Dicranum scoparium*, Hedwig. Ballyhaise woods.

IV.—Fissidentaceæ.

11. *Fissidens taxifolius*, Hedwig. Killakeen, plentiful.

V.—Grimmiaceæ.

12. *Racomitrium fasciculare*, Bridel. Killakeen woods, sparingly.

VI.—Tortulaceæ.

13. *Pottia truncata*, Br. et Sch. Ditch banks, Killakeen.
14. *Tortula convoluta*, Hedwig. Farnham demesne.
15. *Tortula muralis*, Turner (Hedwig). On walls, Killakeen, Ballyhaise bridge, very common.
16. *Tortula lævipila*, Schwægr. On the trunks of trees, Farnham demesne, common.
17. *Barbula rubella*, Mitt. = *Didymodon rubellus*, Schimp. Farnham demesne.

VII.—Orthotrichaceæ.

18. *Zygodon viridissimus*, Brown. On the trunks of trees, Farnham demesne, fertile.
19. *Ulota crispa*, Bridel = *Orthotrichum crispum*, Hedwig. Sp. Musc. p. 162. On the branches of trees and shrubs, forming little yellow-green soft cushions. Slieve Glah, shores of Lough Cultra, Farnham demesne, Killakeen woods.
20. *Ulota phyllantha*, Bridel = *Orthotrichum phyllanthum*, Br. & Sch., Bryol. Europ., vol. 3, Monogr., p. 30, t. 223. On rocks, Slieve Glah. On trees, Ballyhaise woods, shores of Lough Cultra, common.

VIII.—Bryaceæ.

21. *Bryum capillare*, Hedwig. On walls, Farnham demesne, Killakeen, Ballyhaise bridge.

IX.—Fontinalaceæ.

22. *Fontinalis antipyretica*, Linn. On stones, Analee river, at Ballyhaise Bridge.

X.—Cryphaceæ.

23. *Cryphæa heteromalla*, Bridel. On trees, Farnham demesne.

XI.—Neckeraceæ.

24. *Neckera crispa*, Dill. Killakeen woods.

XII.—Leskeaceæ.

25. *Thuidium tamariscinum*, B. & S. Killakeen woods.

XIII.—Hypnaceæ.

26. *Homalothecium sericeum*, Linn., Bryol. Europ., vol. v., Monogr., p. 3, t. 456. On stones, Slieve Glah. On the trunks of trees and on decayed wood, Farnham, Killakeen, Ballyhaise.
27. *Brachythecium rutabulum*, Linn. On old wood, Farnham demesne, bank on the shores of Lough Cultra, common.
28. *Brachythecium populeum*, Hedwig, Sp. Musc., t. 70, fig. 1–6. Killakeen, common.
29. *Brachythecium rivulare*, Br. & Sch. Margin of a lake at Killakeen, sparingly.
30. *Eurynchium myosuroides*, Schimp. On the trunks of trees, Ballyhaise, shores of Lough Cultra.
31. *Eurynchium prælongum*, Schimp. Farnham demesne.
32. *Eurynchium striatum*, Schimp. In damp places, Ballyhaise woods.
33. *Rhynchostegium rusciforme*, B. & S. = *Eurynchium rusciforme*, Milde. In large tufts, Farnham demesne.
34. *Plagiothecium undulatum*, Linn. Damp, shady places, Ballyhaise woods, very fine.
35. *Plagiothecium sylvaticum*, Linn. Killakeen woods, shores of Lough Cultra.
36. *Plagiothecium Borrerianum*, Spruce = *Hypnum elegans*, Hook. Damp bank, Farnham demesne.
37. *Plagiothecium denticulatum*. Br. & Sch. Killakeen.
38. *Amblystegium serpens*, L., Dill. On decayed wood, Ballyhaise and Killakeen.

39. *Amblystegium riparium*, Linn. On wet banks, side of a drain, Farnham demesne.
40. *Hypnum cupressiforme*, Linn. On trees, walls, and rocks, Killakeen, Ballyhaise, Slieve Glah.
    Hypnum cupressiforme, L., *var. filiforme*, Br. Eur. On the trunks of trees, Slieve Glah, Killakeen, Ballyhaise woods, very fine and abundant.
41. *Hypnum resupinatum*, Wils., Eng. Bot., t. 1664. Ballyhaise woods. (Good authorities consider this to be a var. of *H. cupressiforme.*)

HEPATICÆ.

1. *Lunularia cruciata*, Linn. (Dumort) = *L. vulgaris*, Micheli, nov. gen. 4, t. 4. *Marchantia cruciata*, Linn., Sp. Pl., 1604, Carrington and Pearson, Exicc. Fasc. 2, n. 148. Ditch bank, Farnham demesne, near Cavan.
2. *Frullania dilatata*, Linn. (Dumort), Hook, Brit. Jung., tab. 3. On the trunks of trees, Killakeen, Farnham, Ballyhaise woods, Slieve Glah (on rocks).
3. *Frullania tamarisci*, Linn., Sp. Pl., ed. 2, p. 1134, Hook, Brit. Jung., tab. 6. On the trunks of trees, Ballyhaise woods, Killakeen, near the summit of Slieve Glah (on rocks).
4. *Frullania germana*, Taylor in Trans. Bot. Soc. Edin., vol. 2, p. 43, G. L. et N. Synop. Hepat., p. 450. On the trunks of trees and decayed wood, Ballyhaise, Killakeen, Farnham woods, Slieve Glah, sparingly.
5. *Lejeunea minutissima*, Smith = *Lejeunea inconspicua*, Raddi, in Alt. Soc. Modena, 18, p. 34, t. 5, fig. 2. On the trunks of trees about Farnham amongst Metzgeria, very fine epiphytic on Frullania, and at Killakeen on *Hypnum cupressiforme, var. filiforme.* This was the only Lejeunea collected by me in the Co. Cavan. Plants very minute, creeping, irregularly branched. Leaves distant, subrotund, complicate almost the whole length, concave, turgid, sub-papillose. Lobule a little narrower than the lobe. Bracts of the perianth twice as long as the leaves, broadly oblong, slightly complicate, very shortly bilobed, postical lobe twice narrower. Perianth exserted, turbinate, pyriform or compressed, decidedly 5 carinate, papillose, keels with a single row of pellucid cells. Andrœcia on short, robust branches of from three to five pair of altered leaves or amenta, a little smaller than the normal leaves, monandrous. This is

the true plant, which authors have had considerable difficulty in separating from Taylor's *Lejeunea ulicina*, which Dr. Spruce, in his exhaustive work on the Hepaticæ of the Amazon and Andees, puts into a different subgenus Microlejeunia. He places *Lejeunea minutissima*, Smith, and *L. microscopica*, Taylor, into his subgenus Cololejeunia: they are nearly allied, but quite distinct, *L. microscopica* having parœcious inflorescence, while *L. minutissima* is monœcious. Both plants are without foliola or stipules. *Lejeunea inconspicua*, Raddi, cannot rank as a species in the Irish list. It is the same as *L. minutissima*, Smith, *Lejeunea ulicina*, Taylor, is very distinct from the other two minute plants; it is diœcious, and has distinct foliola or stipules. The figures of *Lejeunea minutissima* in English Botany, t. 1633, is correct. The excellent figure in Sir William Hooker's British Jungermania, tab. 52, under *L. minutissima*, is not that species, but *Lejeunea ulicina*, Taylor.

. *Radula complanata*, Linn. Dum., Hook., Brit. Jung., t. 81. On the trunks of trees, Killakeen, Farnham demesne, shores of Lough Cultra.

Radula complanata, L. *var. minor*, Hook. Slieve Glah, Killakeen woods, in perfect condition, differing only in smaller size, more convex and darker-coloured leaves.

7. *Radula voluta*, Taylor., Carrington in Trans. Bot. Soc. Edin., VII., p. 455. *Radula xalapensis*, Lindberg and Moore in Irish Hepaticæ. On trees by the shore of Lough Cultra, very rare, not previously found northwards.

8. *Porella platyphylla*, L., Lindberg, Hook., Brit. Jung., tab. 40, fig. 1 = *Madotheca platyphylla*, Dumort, Comm. Bot., p. 111. On damp rocks, Killakeen woods.

9. *Cephalozia divaricata*, Smith (Dumort), Eng. Bot., t. 719. Spruce in Trans. Bot. Soc. Edin. 3, p. 207. Slieve Glah, sparingly.

10. *Cephalozia Lammersiana*, Huben, Hepat. Germ. 185. *Jungermania bicuspidata*, English Botany, t. 2239. Damp, boggy places, Ballyhaise woods, Slieve Glah.

11. *Cephalozia bicuspidata*, Linn., Hook. Brit. Jung., t. 11, et. supp., t. 4. On decayed wood, shores of Lough Cultra, Slieve Glah. *Cephalozia bicuspidata*, var. *setulosa*, Spruce, Killakeen. A curious dwarf of reddish-coloured form occurs near the summit of Slieve Glah.

12. *Cephalozia catenulata*, Huben, Hepat. Germ. 169. *Jungermania catenulata*, Carrington, in Trans. Bot. Soc. Edin. 7, p. 449, t. 11, fig. 2, *vera*. On decayed wood, shores of Lough Cultra, Slieve Glah, Ballyhaise, amongst Diplophyllum.
13. *Lophocolea bidentata*, Linn. (Dumort), Hook. Brit. Jung., tab. 30. On decayed wood shores of Lough Cultra, Slieve Glah, oak wood, at Ballyhaise.
14. *Lophocolea heterophylla*, Schrad, Hook. Brit. Jung., t. 31. Carrington and Pearson Exsicc, No 36. Paræcious. The Antheridea may be found in the axils of the perigonial leaves, just beneath the perianth; by this character and the various shaped leaves, it is abundantly distinct from *L. bidentata* and *L. cuspidata*, which both have their male flowers in amentæ. On decayed wood, shores of Lough Cultra, fertile.
15. *Saccogyna viticulosa*, Dumort, Hook. Brit. Jung., t. 60. On damp ground, Ballyhaise woods.
16. *Scapania nemorosa*, Dumort, Eng. Bot., t. 607. Carrington and Pearson, Exsicc. 92. On damp ground, Ballyhaise woods.
17. *Scapania aspera*, Muller & Bernet (Plate XXI.); Henri Bernet, Catalogue Hep. du Sud-Ouest de la Suisse et de la Haute-Savoie, 1888. Pearson, in Journal of Botany vol. 30, p. 353, plate 329, 1893.

Diœcious, loosely depresso-cæspitose, of a reddish or olive brown colour. Stems tallish, simple or slightly branched, firm, blackish, recurved at the apex, denudate at the base, radiculose, rootlets few, whitish. Leaves transversely inserted, somewhat smaller and distant below, contiguous, or imbricate above, subsecund, unequally bilobed, margin ciliate-dentate; postical lobe more distinctly ciliate, about twenty-five cilia around the margin; antical lobe, with five to ten or more, distant teeth, about half the size of the postical, convex, oval-triangular, rotundate, or rarely abruptly subacute, appressed to the stem, postical lobe, oval-oblong, rotundate, or rarely abruptly subacute, reflexed; texture somewhat firm, epidermis verruculose, several minute papillæ on each cell; cells small, to rather minute, subquadrate, walls thick, angles thickened, no trigones. Bracts rather larger than the upper leaves, lobes more equal, antical lobe rotundate. Perianth projecting half beyond the bracts, obovate, compressed mouth, wide truncate, spinose ciliate. Male stems more slender, perigonial bracts enclosing leafy paraphyses along with the antheridia. Sometimes gemmiparous. Hab. On

limestone rocks. Ballyhaise wood, plentiful (fertile). This is, so far, the only known Irish locality for the plant which is an addition to the list of Liverworts. It is also found in England and Wales, and on the Continent, Sweden, Switzerland, Germany, Austria, and, possibly it may lurk in Irish Herbaria, under the name of *S. nemorosa*, and, more probably, of *S. æquiloba*. Mr. W. H. Pearson, in his excellent article on the plant, in Journal of Botany, above quoted, writes:—"Although strikingly different in habit from *S. æquiloba* (Schwægr). I am not prepared to say, with the founder of the species, that it has nothing in common with it; the perianth has usually a wider mouth, but the margin is exactly the same; and, although the antical lobe is proportionately smaller and more rotundate at the apex, yet, in *S. æquiloba*, the lobes are not nearly so equal as the name would imply; the most remarkable characters of distinction are found in the antical lobes, which, in *S. aspera*, are more or less rotundate at the apex, which character becomes more noticeable in the bracts; whereas, in *S. æquiloba* they are more oblong and sub-quadrate, the apex is more acute and becomes more accentuated in the antical lobe of the bract; the postical lobes are also more oblong, and acuminate; the postical lobes of both the leaves and bracts are strongly recurved. *S. æquiloba* is a smaller plant, with a neater habit, generally of a dark olive-green colour, leaves regularly inserted, and almost equal in size along the whole stem, margin not so ciliate; teeth smaller and fewer, sometimes subentire, texture more opaque."

18. *Scapania curta*, Dumort. *Jungermania nemorosa, var.* δ *denudata*, Hook. Brit. Jung., t. 21; Carrington, British Hepaticæ, pt. 4, p. 86, pl. 7, fig. 23. On damp ground, between rocks, Slieve Glah, rare (very scarce).

19. *Diplophyllum albicans*, Linn. (Dumort), Hook. Brit. Jung., tab. 23; Eng. Bot. 2240. Damp banks, Ballyhaise wood, Slieve Glah.

20. *Plagiochila asplenioides*, Linn. (Dumort), Eng. Bot., t. 1061; Hook., Brit., Jung., tab. 13. On damp ground, plentiful, very fine in the oak wood, Ballyhaise and Killakeen.

21. *Plagiochila spinulosa*, Dicks (Dumort), Hook. Brit. Jung., t. 14. Damp bank, Ballyhaise wood.

22. *Jungermania* (*Apolozia*) *pumila*, Withering (Dumort), Hook. Brit. Jung. t. 17; Carrington and Pearson, Exs. No. 102. On wet rocks, Ballyhaise wood, very scarce.

23. *Jungermania* (*Lophozia*) *barbata*, Schreber, Hook. Brit. Jung., t. 70; Eng. Bot., t. 2547. Damp bank, amongst Diplophyllum, on Slieve Glah, very scarce.

24. *Jungermania* (*Lophozia*) *ventricosa*, Dicks, Hook. Brit. Jung., t. 28; Carr and Pearson, Exs. No. 171. Damp bank, Slieve Glah, scarce.

25. *Jungermania* (*Lophozia*) *alpestris*, Schl.; *Junger. alpestris*, Schleich. Exs., cent. 2, n. 59, Nees., Europ. Leberm, 2, p. 104, G. L. et N. Syn. Hepat., p. 113. Damp bank, Slieve Glah, sparingly.

Diœcious, stem strong, creeping, or erect from the upper half, simple or devaricately branched near the apex, clothed on the under side with white rootlets, which is often violet-coloured for its whole length. Leaves in two rows, vertical, increasing in size from the base upwards, sub-quadrate, two-lobed, rarely three-lobed, segments of various depths, acute or obtuse, often widely and obtusely notched at the apex, sinus shallow, in some leaves scarcely perceptible. Perichætial leaves three or four times acutely divided; stipules, none. Perianth obovate or obovate oblong, terminal or lateral. Antheridia remarkably large, placed singly at the base of each leaf, which is closely imbricated and saccate at the base, patent at the apex, recurved, of a pale violet colour.

This interesting plant was first reported from Kinnordy[1] (Co. Kerry?), where it was collected by Dr. Taylor many years ago. I cannot find any record of its reappearance in Ireland, till I rediscovered it on Benbulbin, Co. Sligo, in 1881, when collecting plants there with Mr. F. W. Moore, A.L.S. I was in some difficulty as to what to refer it to, as the specimens bore no perianth, and I sent a portion of what I gathered to Mr. M. B. Slater, F.L.S., of Yorkshire, an excellent authority on liverworts, who preserved my specimen to be further examined, in the hope of my being able to find it in some other locality, and in more perfect condition, which I was fortunate enough to do a few years later, gathering ample material in the Co. Wicklow, in good condition. *Jungermania excisa*, Dicks, Hook., Brit. Jung. Supp., t. 2, collected near Dublin by Dr. Taylor, probably also belongs to *Jungermania alpestris*. Referring to it, Dr. D. Moore states in his excellent paper on the Irish Hepaticæ:—"This plant has not turned up among the widely extended gatherings made by me in many parts of Ireland,

[1] Dr. Carrington, "Gleanings among the Irish Cryptograms," Trans. Bot. Soc. Edin. vol. VIII. p. 379.

nor have I seen Irish specimens of it" (Proc. R.I.A., 2nd Ser., vol. ii., Science, p, 652). The ventricose group of Jungermania are difficult to identify without a series of specimens in good condition. The descriptions given in synopsis by authors are often too brief, and suggest slight differences when the plants are distinct enough.

26. *Jungermania* (*Gymnocolea*) *inflata*, Huds., Hook., Brit. Jung., t. 38; Carrington and Pearson's Exsicc., No. 28–29. Moist bank near the summit of Slieve Glah.

27. *Nardia emarginata*, Ehrhart (B. Gr.), Hook., Brit. Jung., t. 27. Wet rocks, Ballyhaise wood, Farnham demesne.
Nardia emarginata, *var. minor*. On stones near the summit of Slieve Glah.

28. *Nardia scalaris*, Schrad., Hook., Brit. Jung., t. 61; Carrington, Brit. Hepat., p. 23. Moist bank, Slieve Glah, shore of Lough Cultra.

29. *Nardia hyalina*, Lyell, Hook., Brit. Jung., t. 63; Carrington, Brit. Hepat., p. 35, pl. 11, fig. 36. Damp bank near the summit of Slieve Glah.

30. *Nardia obovata*, Nees, Gottsche et Rabenhorst, Hepaticæ Europæa, No. 266, with excellent figure and description by Dr. Gottsche; Carrington, Brit. Hepat., p. 32, pl. 11, fig. 35. Moist bank amongst stones, Slieve Glah. A well-marked plant, easily separated from the two species, 28 and 29, by the purple rootlets and the involucral bracts, two pairs which are larger than the leaves, the two upper opposite, and connate for more than half their length.

31. *Nardia crenulata*, Smith (Lindberg), Eng. Bot., t. 1463; Hook., Brit. Jung., t. 37. *Aplozia crenulata*, Hep. Europ., p. 57. Damp banks, Slieve Glah, sparingly.

32. *Nardia gracillima*, Smith (Lindberg), Sm. Eng. Bot., 2238. *Aplozia gracillima*, Dumort, Hepat. Europ., p. 57. On damp ground, Killakeen, Slieve Glah, on the shores of Lough Cultra.

33. *Blasia pusilla*, Linn. *Jungermania Blasia*, Hook., Brit. Jung., t. 82–84. Side of a drain, Killakeen.

34. *Pellia epiphylla*, Linn., Sp. pl. 1, ed. 2, p. 1135, Hook., Brit. Jung., t. 47. On a damp bank, Farnham demesne, Killakeen, shores of Lough Cultra.

35. *Metzgeria furcata*, Linn. (Dumort), Hook., Brit. Jung., t. 55, 56. Diœcious, fronds linear, flat, dichotomously forked, smooth on the upper surface, margin and costa beneath subpilose; fruit rising from the mid-rib or nerve on the under side,

calyptra setulose, forming dense patches closely pressed to the surface, of a pale green colour. On the trunks of trees, Farnham demesne, Ballyhaise woods, Killakeen, Slieve Glah.

Metzgeria furcata, var. β fruticulosa, Dicks, Lindberg. Monogr. Metzgeria = *Jungermania fruticulosa*, Eng. Bot., vol. 35, tab. 2514. *J. furcata, var. β æruginosa*, Hook., Brit. Jung., in textu ad tab. 55 et 56.

Growing on the bark of trees in compact, crisped tufts, not unlike some of the larger algæ; fronds dilated near the apex, sharply forked, with the margins shallow and closely recurved, giving the ramuli the appearance of being reduced to the nerve. The colour is a striking verdigris green or blue-green, especially brilliant near the apex of the frond, which is erect or ascending, bearing copious gemmæ at the apex. Farnham demesne, plentiful; oak wood, at Ballyhaise.

36. *Metzgeria conjugata*, Dill. (Pl. XXII.); Lindberg's Monogr. Metzgeria.

Autœcious; fronds robust, not much elongated, more or less dichotomous, irregularly pinnated or decomposite, linear, narrower in some parts than in others, in tranverse section semilunar, hairs longish, singly, often in pairs, on margin and divergent. The paucity of hairs and more horny substance of the fronds with copious innovations, and the autœcious or monœcious inflorescence abundantly distinguish this species from *M. furcata*, which is diœcious, and all other known species of this singular genus. On the trunks of trees, Farnham demesne, Ballyhaise woods, shores of Lough Cultra on Frullania.

37. *Riccardia multifida*, Dill. (Linn.), Eng. Bot., t. 186; Hook. Brit. Jung., t. 45. On damp ground, Killakeen.

38. *Riccardia sinuata*, Dicks = *Jung. pinnatifida*, Nees in Mart. Fl. Brus., p. 327. *Aneura pinnatifida*, Dumort. In moist shady places, Killakeen (sparingly).

39. *Riccardia palmata*, Hedwig (Lindberg); *Jungermania palmata*, Hedwig, Theor. Gen., ed. i., p. 87, tab. 18, figs. 93–95, et tab. 19, figs. 96–98; Cook, Handbook Brit. Hepat., pl. 7, fig. 91; Carrington & Pearson's Exsicc., No. 204.

Diœcious; fronds short, rather crowded, free at the apex, palmately cut, segments linear, and frequently tapering to a point or slightly emarginate; involucral bracts small; calyptra small and densely verrucose. On decayed wood, shores of Lough Cultra. This is the only northern station for the plant known to me.

EXPLANATION OF PLATES XXI. AND XXII.

Plate XXI.

Scapania aspera, Müll.

Fig. 1. Plant, twice natural size.
2. Portion of a branch with perianth, ventral aspect. × 10.
3. The same dorsal aspect. × 10.
4. Perianth and involucral bracts. × 15.
5. Young shoot, bearing gemmæ buds at apex. × 10.
6. Leaf. × 16.
7. Involucral bract. × 16.
8. Cells and margin of leaf. × 275.

Plate XXII.

Metzgeria conjugata, Dill., Lindberg.

Fig. 1. Plant, natural size.
2. The same, × 10, showing monœcious character.
3. The normal branching habit of the plant.
4. Proliferous budding frequently seen in Metzgeria. × 10.
5. The setulose calyptra or perianth. × 20.
6. The same, with elevated capsule and involucre, which encloses the antheridia. × 20.
7. Involucre, which encloses the antheridia. × 120.
8. Valve of the capsule and persistent elaters (one spired). × 120.
9. Portion of thallus or frond showing marginal hairs. × 120.

XXVI.

ON THE EFFECTS OF STIMULATIVE AND ANÆSTHETIC GASES ON TRANSPIRATION. (PRELIMINARY NOTE.) BY HENRY H. DIXON, D.Sc., Assistant to the Professor of Botany, Trinity College, Dublin.

(COMMUNICATED BY E. P. WRIGHT, M.D.)

[Read JANUARY 10, 1898.]

IT has been pointed out[1] that experimental data do not allow us to decide whether the energy which raises the sap in tall trees during transpiration is directly derived from the inflow of heat at the evaporating surfaces in the leaves, or whether the energy is, at least in part, derived from the potential energy stored in the form of various oxidisable substances in the leaf. In other words, whether transpiration is a purely physical process, or whether it is complicated by phenomena which biologists describe as vital processes.

This investigation is an attempt to elucidate this point. It was hoped that, by observing the effects of stimulative and anæsthetic gases on transpiration, we might obtain a clue as to the nature of the process. Thus, if it was noted that a gas like oxygen, which stimulates the vital actions of protoplasm, caused the rate of transpiration to increase markedly, this observation would tend to show that transpiration might with probability be referred to vital action. Again, if the action of anæsthetics tended to retard transpiration, we would have in this fact additional evidence pointing in the same direction; whereas; if these gases were without special effects on the process, other than their simple physical properties would exert on evaporatian we might conclude that so far transpiration was similar to evaporation.

The direct effects of the stimulating and anæstheticising gases are, however, complicated by other attending phenomena; so that the results, so far as I have been able to proceed, are neither easily obtained nor are they of unequivocal interpretation.

The method of experiment was as follows:—The rate of transpiration of a branch enclosed in a large receiver, and supplied with a

[1] "Report of a Discussion on the Ascent of Water in Trees," Ann. Bot., Dec. 1896, and "On the Physics of the Transpiration Current, p. 34.

constant current of dried air, was observed. This rate was then compared with the rate of transpiration, when a similar current of some other dried gas, or dried air, carrying with it some anæstheticising vapour, was passed through the receiver.

The rate of transpiration was estimated, either by the motion of an index moving in a capillary tube sealed hermetically to the cut end of the branch, or by directly weighing the amount of water transpired. In the latter case, which was found to be the more satisfactory, the branch, inserted through a caoutchouc cork into a test-tube containing water, was hung from one arm of a balance. The arrangement is shown in the figure. In this figure *b* is a 'tower' containing calcium

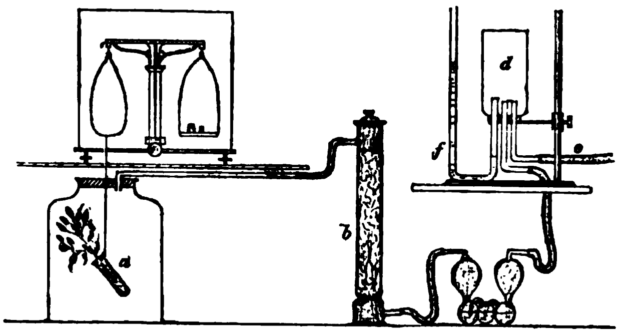

FIG. 1.

chloride, aud *e* is a sulphuric acid bulb for drying the gas supplied. Before passing through the drying materials, the gas entering at *e* is led into an inverted flask *d*, which is provided, in addition to the tubes of entry and exit, with a U-tube, *f*, filled with oil. The supply of gas is adjusted until the oil in the longer arm of the tube *f* is brought to a certain level. By this means the pressure, and consequently the flow, of gas through the apparatus can be adjusted and compared. When vapours are to be supplied, the liquid from which the vapour is derived is placed in a sulphuric acid bulb, like that in the figure, but inserted in the train between the air supply and the flask *d*.

The first experiments made were with the index method of estimating the rate of transpiration. A modification of the apparatus, as figured, which is readily understood, was then used. The branch, sealed hermetically to a capillary tube containing the index, was then inserted from below into the receiver..

With these arrangements there soon appeared to be a marked difference in the rate of transpiration in oxygen and CO_2. Thus, to quote

the mean of a number of observations with a branch of *Cytisus Laburnum* in CO_2. the index moved 1 cm. in 38″; with the same branch in oxygen it moved 1 cm. in 28″.

When the rate of transpiration in air was compared with that in oxygen, it was found that when a branch was surrounded with the latter gas, transpiration was slightly more rapid. The index for the branch in air moved 1cm. in 36″; for the same branch in oxygen it moved 1cm. in 33″.

If, while a current of air was passing through the receiver, a piece of cotton wool soaked in chloroform was introduced, a much more marked differenee in the rate of transpiration became apparent in a short time. Thus the index was traversing 10cm. in 50·8″ when chloroform was introduced; at the end of 30 minutes it took 516″ to traverse the same distance. The chloroform was then removed, and the air current maintained for 60 minutes. At the end of this time the index moved 10cm. in 120.″ This result is the mean of a number of experiments made with a small branch of *Acer macrophyllum.*

With another branch in air the motion of the index was 10cm. in 127″. When surrounded with chloroform vapour for 45 minutes the index took 642″ to traverse the same distance.

A similar diminution in the rate of transpiration is observed when the branch is surrounded by ether vapour. Thus, with a branch of *Acer macrophyllum* in air, the index moved 10cm. in 205″; with the same in ether vapour it moved 10cm. in 265″.

These experiments indicate a large difference in the rate of transpiration in the rate of different gases. The figures given here will serve only as examples of the results of such experiments, for, although they were the means of a number of observations, these latter are made so precarious by a number of circumstances, that they can only be taken as indicating a difference, and not as giving a measure of it. The sticking of the index in the capillary tube, and the opening of the receiver to introduce the anæsthetics, bring in errors, which render the method unsuited to exact observation.

In order to eliminate these sources of inexactness I had recourse to the arrangements shown in the figure. The results obtained by this method are displayed in the following tables. The difficulties of keeping the flow[1] of gas exactly constant through the apparatus, and other experimental errors, lead to variations between the individual observations often amounting to 10 per cent.; but by multiplying these

[1] It is to be observed the rate of flow of the different gases will be different, even if the pressure be the same.

observations it is hoped that, at least, an approximation to the actual alteration in the rate of transpiration has been obtained. The numbers here given are the means of a large number of observations. In each case, the branches experimented on were from a tree of *Syringa vulgaris*, except in the last set of experiments, where effect of ether vapour was observed. In these last, branches of *Cytisus laburnum* were used.

TABLE I.

No. of Observations.	Medium.	Temperature.	Amount transpired in 30′.
20	Oxygen, . . .	18·2°	·140 grs.
	Air, . . .	18·2°	·103 grs.
15	CO_2, . . .	15·8°	·103 grs.
	Air, . . .	15·7°	·118 grs.
10	Chloroform, . .	20·5	·077 grs.
	Air, ...	20·8	·116 grs.
10	Ether, . . .	19·1	·237 grs.
	Air, ...	19·0	·283 grs.

If the amount transpired in air be taken as 100, the amounts transpired in the other gases are as follows. This may be said to denote to the specific transpiration for these gases:—

TABLE II.

Medium.	Specific Transpiration.
Oxygen, . . .	135·8
Air, ...	100·0
CO_2, ...	87·3
Ether, ...	82·3
Chloroform, . .	66·4

The first source of error effecting these experiments, and one

which it seems hard to eliminate, arises from the fact that the effects of the different gases may be more or less rapid. Thus it is very certain that the light gases (*i.e.* those with small molecules) will diffuse into the intercellular spaces more quickly than the heavy gases, and so come into contact with evaporating cells more quickly. Besides this, it seems probable that the poisoning and anæsthetic effects of one may be more rapid than those of another. The observations, on which the numbers given above are based, were commenced in each case after the branch had been surrounded by the gas for five minutes, and were discontinued before any lethal could be observed in the leaves; for such, if arising, would cause the osmotic pressures obtaining in the leaf-cells to become diminished, by rendering the protoplasmic membranes permeable. These effects were usually visible within 45 minutes after starting the experiment. It is possible that the denser vapour could not, within this time, diffuse into all the intercellular spaces of the leaves.

An error arising from this possibility is most unsatisfactory, as it seems extremely difficult to make proper allowance for it. It seems impossible, at present, to decide how soon the surrounding gas will come into contact with the evaporating cells, and, also, when the anæstheticising or stimulating action will cease, and the lethal effects will begin, if, indeed, there is any sharp line of distinction.

Next we come to an error which can, in some degree, be eliminated.

It is known that the rate of diffusion of a gas will be influenced by the nature of the gas occupying the space into which it is diffusing Thus water-vapour will diffuse more slowly into CO_2 gas than into oxygen. This difference depends on the relative sizes of the molecules of the gases into which the water-vapour has to diffuse. For the same pressure and temperature, there will be the same number of molecules of these gases in the surrounding space; but if their sizes are different, it is plain that the water-molecules will less readily diffuse into the space occupied by the gas composed of the larger molecules.

In order to form some idea of this effect, I suspended a shallow dish containing water in the receiver, previously occupied by the transpiring branch; and in connexion with the train of apparatus previously described, successive weighings gave approximately the loss of water by evaporation from this dish. During the experiment a stream of gas dried, as before described, was kept up through the

apparatus. The rate of evaporation, when this current was composed of air, oxygen, carbon dioxide, and largely of ether and chloroform, was observed, and is recorded in the following table. The evaporating surface in each case was 41 sq. cms. :—

TABLE III.

Medium.	Temperature.	Evaporation in 30 min.
Oxygen, . . .	14·7	·098 grs.
Air, ...	14·7	·094 grs.
Ether, ...	15·6	·074 grs.
Air, ...	15·4	·092 grs.
Chloroform, . . .	18·7	·077 grs.
Air, ...	18·3	·132 grs.
CO_2, ...	15·2	·096 grs.
Air, ...	15·1	·108 grs.

From this table it results, if we denote the loss of weight of a vessel of water in air as 100, the loss in the other gases will be as follows :—

TABLE IV.

Medium.	Specific Evaporation.
Oxygen, . . .	104
Air, ...	100
CO_2, ...	89
Ether, ...	81
Chloroform, . .	59

The following table combines Table II. with Table IV. for the sake of comparison :—

TABLE V.

Medium.	Specific Transpiration.	Specific Evaporation.
Oxygen, . . .	135·8	104
Air, ...	100·0	100
CO_2, ...	87·3	89
Ether, ...	82·3	81
Chloroform, . . .	66·4	59

From this table it would appear that the rate of transpiration is diminished when the leaves are surrounded by CO_2, ether vapour, or chloroform, much in the same degree as the rate of evaporation would be diminished by the presence of these gases. In the case of oxygen, however, the rate of transpiration is increased much more than the rate of evaporation would be from a liquid surface.

It must be understood that these numbers only apply to the first effects of CO_2, ether, and chloroform; for when these gases begin to exercise a killing action on the cells, the rate of transpiration is very markedly diminished, presumably owing to the reduction of the osmotic pressure in the cells.

The experiments both on transpiration and evaporation are exposed to two common errors—*e.g.* a certain amount of gas will be dissolved in each case by the liquid present, and this will reduce the loss of weight, and so diminish the rate in both cases. Again, this solution of the gas in the liquid may alter the surface tension, and so modify the rate of loss.

With regard to oxygen, the case is different. The increase in the percentage of this gas increases the rate of transpiration much more than that of evaporation. But, unfortunately, this does not decide the problem as to whether transpiration is facilitated by a vital action in the evaporating cells, or whether the upward current is simply due to the inflow of heat at their evaporating surfaces. Oxygen may increase the rate of transpiration by liberating heat in the evaporating cells by the oxidation of combustible materials there. The increase in the rate of exhalation of water from a leaf surrounded with oxygen would

in that case be due to a rise in temperature, and to an increased facility to diffusion at the seat of evaporation; and the more complex processes of vital action taking place in the protoplasm need not be appealed to. These two causes would then be responsible for the fact that the rate of transpiration is about 30 per cent. greater in oxygen than in air But, again, it may be that vital processes giving rise to pumping actions (to which I have already alluded as possibly occurring in the leaf-cells) may be made more vigorous by the greater quantities of oxygen available for respiration—that, in fact, these actions, in common with vital processes generally, are quickened when respiration is more vigorous.

With the other gases there is practically no difference between the specific transpiration and specific evaporation. The logical conclusion from this seems to be that these gases were without effect on the vita actions of the leaf-cells, so far as transpiration is concerned, during the experiment.

Thus the problem as to how far pumping actions, taking place in the leaf-cells at the expense of the stored energy of organic compounds, accelerate transpiration is not yet decided; but I think it will appear that the evidence of the foregoing experiments, although by no means decided, favours the view that such actions largely control the elimination of water from the transpiring cells. Other evidence in favour of this view I have cited in my paper on the Physics of the Transpiration Current.[1]

However this question is ultimately decided, I think the subject matter of this research is not without its bearing on plant physiology.

It is a matter of frequent observation that many plants which are natives of arid regions, secrete a relatively large amount of ethereal oils. It has been urged[2] that the vapours of these ethereal oils form a screen which arrests the heat radiations, and thus the leaves of the plant are kept cooler than they otherwise would be. It might, however, be said against this theory that such an absorptive screen in contact with the leaves (and it would evidently be most effective at the surface of the leaves) would rather tend to raise their temperature. Be that as it may, it seems that the property of vapours in checking evaporation, emphasised by this research, afford a simpler explanation of the function of these oily secretions. When the vapour of the ethereal oils is liberated from the leaf-tissues, it will surround the

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[1] "Notes from the Botanical School, T. C. D." No. 2, p. 88, 1897.

[2] "The Origin of Plant Structures," George Henslow, p. 82.

leaves, and fill the intercellular spaces. In these positions we might expect that the vapour will exert a retarding action on transpiration and evaporation, in accordance with the experiments quoted above. I have only been able to make a few experiments on the matter as yet, but these indicate the surmise given here is correct. I found that the vapour given off from chopped-up leaves of *Artemisia Absinthium* reduced the rate of transpiration very considerably. Thus, if we denote the rate of transpiration of a branch of *Syringa vulgaris*, in a current of dry air, as 100, this rate will be reduced to about 87 if we allow the air-current to pass over chopped leaves of this *Artemisia*, and so carry some of the vapour given off by these leaves round the transpiring branch. The air is, of course, dried after passing over the leaves. In a similar manner I found that the same vapour reduced the rate of transpiration of a branch of *Cytisus Laburnum*, from 100 to 93. In these experiments the temperature lay between 16° and 17° C. At higher temperatures, it is possible that the effects would be more marked.

XXVII.

TRANSPIRATION INTO A SATURATED ATMOSPHERE.

By HENRY H. DIXON, D.Sc., Assistant to the Professor of Botany, Trinity College, Dublin.

(COMMUNICATED BY E. P. WRIGHT, M.D.)

[Read January 10, 1898.]

Many observations and considerations[1] have led me to suspect that the tension transmitted in the water-containing capillaries of transpiring plants, is not simply referable to evaporation taking place at the liquid surface in the imbibed membranes of the leaf-cells. And it seemed probable that pumping actions proceeding in these cells (analogous to the pumping actions of root-cells manifested during the "bleeding" of plants) may be directly responsible for the elevation of the transpiration current.[2]

If this be true, the elevation of water in the capillaries during the transpiration of living plants is effected by a "vital" process, and in this respect resembles the raising of water in plants by root-pressure, and the transference of water in cœnocytic fungi. Of course the water of the transpiration-current must be *drawn* up by the leaf-cells, and so the process differs from the other examples, in which the water is *pushed* up by the living cells.

In thus ascribing the lifting of water to a "vital" and not a "physical" process going on in the transpiring cells, it must not be thought that any ultraphysical phenomena are presupposed. To guard against such a misapprehension, it may be well to state that, by "vital" processes are here meant, processes which cannot be accounted for by the immediate energy-relations of the organism to the external world, but those in which energy previously stored by the organism, *e.g.*, as oxidisable materials, is utilized, and which only take place during the life of the organism.

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[1] "Report of a Discussion on the Ascent of Water in Trees," Ann. of Botany, December, 1896, p. 651.

[2] "On the Physics of the Transpiration Current," Notes from the Botanical School, T. C. D., No. 2, 1897, p. 88.

Under normal circumstances transpiration is effected under conditions favourable to evaporation. The transpiring surfaces are at such a temperature that the vapour-pressure in the surrounding space is less than at the surface of the transpiring cells. To maintain this temperature, the leaves of the plant are free to receive light and heat radiations, and heat may be conducted into them, as evaporation tends to lower their temperature below that of their surroundings. This inflow of energy from the external world must, under ordinary circumstances, be taking place during transpiration. In addition to these sources of energy, the cells of the leaves may do work at the expense of the potential energy of the store materials they possess. This stored energy, which is, of course, ultimately derived from the radiant energy entering the plant, is the only remaining source of energy available for the leaves.

If, when the radiated energy is cut off, and the conditions are such that water tends to condense on the leaves from the surrounding space, the cells of the leaves still continue to draw up water in the capillaries, then the work done must be at the expense of the stored energy; and, if this work is no longer continued, when the leaves are killed, we may fairly ascribe it to *vital* actions pumping or drawing up water from the conduits of the plant.

It may be pointed out here that this energy could only be made available when the store materials can obtain the requisite oxygen from the plant's surroundings, or from its own substance. And so, in common with other vital actions, it would cease when oxygen is not available.

Supposing, then, we find that the upward motion of the transpiration current continues when radiated energy is cut off, and when the leaves are surrounded by a space saturated with water vapour, we are driven to conclude that the traction exerted on the ascending water is exerted by a vital action, and we can no longer assume that simple physical processes, exactly corresponding to the actual inflow of energy, at the moment, can account for the elevation of water in such a case. On the other hand, the converse will be true if no elevation of water occurs in the plant when it is submitted to the conditions described.

To put this matter to an experimental test, the following arrangements are made:—A small branch about 30 cms. long is cut and set in water in a cool, dark cupboard. From this it is transferred, still standing in water, under a glass receiver. The internal walls of the receiver are kept wet. After remaining one hour under the receiver, and still screened from light, it is assumed that any reduced

gas pressure existing in the water conduits has become equalized to that of the atmosphere, and that, consequently, the external pressure exerted at the base of the branch has ceased to move the water upwards. An open beaker, containing water at 100° C., is now introduced under the rceeiver, and the branch is transferred from the water to a watery solution of eosin. A wooden screen is set to cut off the direct radiation of the beaker from the branch. These arrangements are made in a dull light, and, when complete, the whole is set in total darkness.

As soon as the beaker containing the hot water is introduced under the receiver, the space included will immediately be filled with cloud and water vapour. Water is freely deposited on the walls of the receiver and on the surfaces of the leaves of the plant. The space is completely saturated, and remains so, as it continues to fall in temperature, owing to the gradual cooling of the whole; and, as the water is always at a higher temperature than the leaves, a constant distillation goes on from the beaker to the leaves. The arrangements are shown in figure 1.

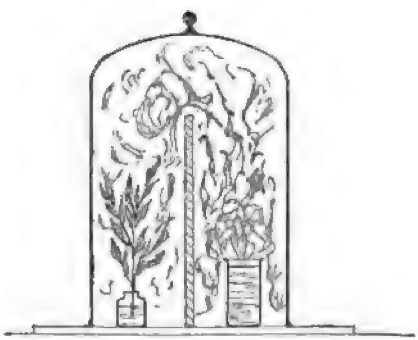

FIG. 1.

When these arrangements have been made the apparatus is left for one hour. At the end of this time, it will be found that the eosin solution has been drawn up very markedly into the plant, thus showing that the elevation of the water in the conduits may be effected by vital action. For in this experiment the immediate energy relations of the plant to its surroundings cannot account for the rise. I have performed this experiment, with the same result, with *Chrysanthemum sinense*, *C. lacustre*, *Myrtus communis*, *Eucalyptus*, *globulus*, *Escallonia macrantha*.

As we would expect, it was found that, when dead leaves and branches were set in this saturated chamber, no rise of the eosin was observed, although simultaneously eosin was drawn up into living specimens placed side by side with the dead ones. The dead branches, which I used, had been killed by chloroform vapour, or by immersion for some minutes in water at 90° C.

In these experiments when the coloured fluid was drawn up only into the capillaries of the stem, the pumping action raising it may have been discharged either by the cells bordering the conduits in the stem, or by those in a similar position in the leaves. But when the veins of the leaves become injected, it is evident, since no cells interrupt the continuity of the water-conducting capillaries, that the cells exerting the traction in the fluid must be situated in the leaves.

This fact may be more directly demonstrated by experiments in which the ascent of watery eosin in a branch stripped of its leaves is compared with that in a similar branch provided with leaves, when both are placed in the saturated chamber. It will be found—I have performed the experiment with *Chrysanthemum sinense*, *Escallonia macrantha*, *Cheiranthus Cheiri*—that the leafy branch will draw up the eosin rapidly, while under similar circumstances the colouring matter will rise but slightly—a few cms. per hour—in the branch deprived of its leaves. The rise observed may be easily explained by the supposition that, in the green parts of the young branches and the buds, the cells probably act like those of the leaves, and draw up water by a pumping action; or, again, the action of the cells bordering the capillaries of the stem—wood-parenchyma and medullary rays—may be responsible for the elevation observed. In any case the rise is but slight, 3–5 cms. in the stripped branches, compared with 20–30 cms. in the leafy branches during the same time.

That the elevating force is chiefly located in the leaves may also be shown by the fact that large leaves detached from the stem are capable of quickly injecting the finest veins at their apex when set upright in watery eosin in the saturated chamber. For this purpose I used the leaves of *Eucalyptus globulus*, and found that their apical veins were injected often after standing only 30 min. in eosin, and surrounded with a saturated atmosphere. The eosin, to do this, had risen 20 cms. in the leaf above the level of the solution in which the leaf stood. In this case it is evident that the cells of the leaf must have been solely responsible for the observed elevation.

But the directed pumping actions which cause the elevation of the coloured fluid in these cases, although mostly confined to the leaf, do

not appear to be restricted to any special cells forming water-glands on the surface of the leaf. It seems most probable that most or all of the cells bordering on the vascular capillaries, both in leaf and stem, are able to exert a tractional force on the water in the conduits, and are able to expel water, when thus drawn in, on their outer surfaces. It may be, however, that the cells of the water-glands of plants are more highly specialized for this function, and hence the exudation of drops on leaves of plants in moist atmosphere takes place over these glands or hydathodes, as Haberlandt prefers to call them.

The following observation shows that the elevation of the water is not solely due to the functioning of these water-glands, even in plants possessed with these structures. The leaves of *Escallonia macrantha*, *Chrysanthemum sinense*, and *Chrysanthemum lacustre* have water stomata on the margin of the leaf; but if these glands are removed by cutting away the whole margin with a scissors, it will be found that water will be drawn up into these leaves through the stem almost as quickly as into the leaves of a branch which are left intact.

Another observation which shows that the traction is exerted by cells of the leaf, which are not visibly differentiated, may be made on *Cheiranthus Cheiri*. The leaves of this plant, so far as I can make out, have no specialized water-glands. However the extreme apex often withers away in the older leaves, as if some substance had been exuded there from the leaf. In case this tip be the seat of a water-gland, it is removed from all the leaves of a branch which is set in the saturated chamber. After a suitable time it will be found that the coloured fluid has risen into all the veins of the leaves, and it will be seen in the ultimate blind terminations of the vascular bundles. In *Cheiranthus Cheiri* these terminations are surrounded by cells undifferentiated from the other cells of the mesophyll of the leaf. The coloured fluid must have been drawn into the terminal portions of the veins by these cells, and not by any specialized water-glands. We may conclude that the similar cells along the conduits have the same function.

Of course it is quite possible that the cells forming the water-secreting tissue of the water-glands have this pumping power more highly developed than that possessed by the cells situated all along the conduits. Hence, in Gardiner's[1] experiments, the expulsion of water occurred in noticeable quantities only over the water-glands. He found that drops of water are exuded from the water-glands of

[1] Proc. Cambridge Phil. Soc., vol. v. 1884.

Impatiens, Fuchsia, Limoniastrum, and Polypodium, if cut branches of these plants are set in water in a moist place. His results have been confirmed by Haberlandt[1] and Nestler,[2] though curiously enough the last-named author attributes the dropping to a filtration of water through the water-gland due to the pressure from behind. Haberlandt and Pfeffer,[3] however, are agreed that the expulsion of the water is due to the vital activity of the cells of the gland. In the experiments alluded to there seems no probability of any pressure existing in the water in the conduits tending to expel water from them.

It was usually found at the end of all the experiments conducted in the saturated chamber that the surfaces of the leaves had a copious deposit of water upon them, and so it seemed probable that water was actually extruded from the cells of the leaf even after water had begun to condense on them from the surroundings.

The actual presence of free liquid on the surface of the leaves apparently did not markedly diminish the rate of rise of the coloured fluid in the branch, and so, if the branch was immersed in water before commencing the experiment, it was found that the eosin mounted notwithstanding into the dripping leaves.

In these cases, the pumping cells, being surrounded by water, must possess a directed action, drawing the water in on one side from a liquid supply, and expelling it on the other into free liquid.

This directed action may be more strikingly demonstrated by the following experiment:—A branch is fixed water-tight into the lower narrow opening of a glass receiver, so that its upper part and leaves project into the receiver, while its base extends beyond the cork in the neck, and is supplied with a solution of eosin (see fig. 2). If the receiver be filled with water, so that the leaves of the branch are completely submerged, it will be found that, notwithstanding the presence of the water in contact with the leaves, and the hydrostatic pressure due to its depth, the eosin will mount rapidly into the branch.

In some of my experiments the pressure of the water was sufficient to drive liquid back into the intercellular spaces of the leaves of the branch. So that it appears that the pumping action can raise water against a considerable external hydrostatic pressure.

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[1] Sitzb. d. k. Akad. d. Wissenschaft in Wien. Bd. ciii.

[2] *Ibid.*, Bd. cv.

[3] Pflanzenphysiol. Bd. i. 174, and Haberlandt, Jahrb. für wissenschaftliche Botanik, 1897.

In carrying out this experiment, of course, care must be taken that the gas-pressure in the branch has become equalized with that of the atmospherė. With this precaution, however, the result seems conclusive, *i.e.* that pumping actions, and not evaporation cause the rise of the eosin into it.

It will be found that, if the water in the receiver is warm (25°–30° C.), and if the apparatus is placed in a strong light, the

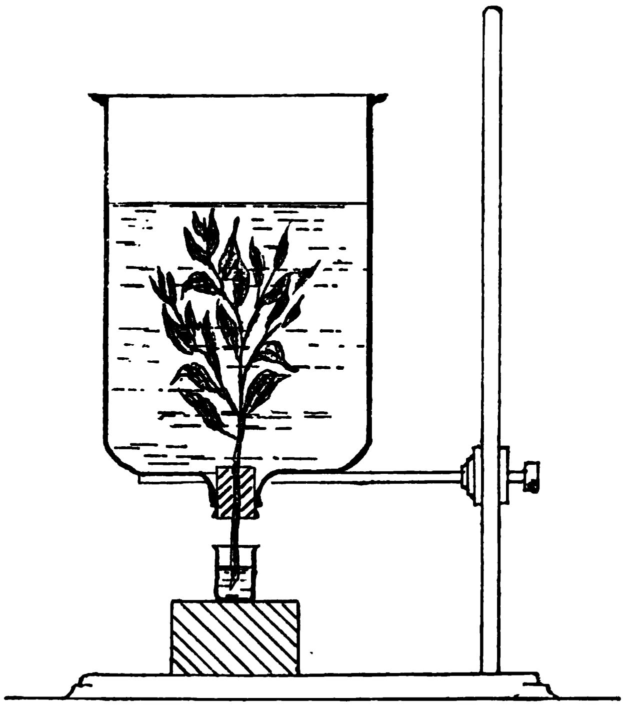

FIG. 2.

ascent of the eosin will be rapid; if, on the other hand, the water is cold (below 12° C.) and the light is not strong, the eosin will rise but slowly in the branch. If the apparatus is placed in darkness, the eosin will rise but little or not at all.

It seems probable that the increased rate is, in part, due to the quickening of the vital processes due to the rise in temperature when the water surrounding the leaves is warm.

The stimulating action of the light is indirect, and probably is effective by the increased supply of oxygen set free by assimilation. The rising of the eosin is most vigorous when bubbles of oxygen are being rapidly evolved at the surface of the leaves. This observation, then, constitutes another proof that the raising action is due to a vital process, and ceases when the supply of oxygen is cut off. In this respect the action resembles other vital phenomena, such as growth, irritability, &c. The fact that a small rise does take place in the dark is explained by the presence of oxygen in the water, and also of that derived by intra-molecular respiration.

The combination of this oxygen will of course lead to a minute rise in temperature which will favour a distillation of water from the leaves. This effect, however, would probably be so small that it could not account for the rapid rise of water in plants in a saturated space as has been described in this note.

From what has been here detailed, I think we may with great confidence assert that the elevation of the sap, when plants are situated in saturated spaces, is effected by directed actions taking place in the living cells of the leaves, and to some extent perhaps in those of the stem. Simple osmotic and evaporative forces cannot be effective in raising the water in the conduits under these circumstances. With regard to the elevation of water, when the leaves are surrounded by an unsaturated atmosphere, we cannot as yet be dogmatic. But the fact that, when the leaves of plants are killed, they dry up and are unable to furnish themselves with sufficient water from an unlimited supply at the base of their stem, argues that surface tension and evaporation forces at their surfaces are in themselves inadequate. And when we couple with this the observations on the directed vital actions taking place in the leaf-cells when they are surrounded with a saturated atmosphere, I think we may, with great probability, assume that these directed vital actions are responsible to a great extent for raising of water in plants even in unsaturated spaces. In any case the present experiments show that these directed vital actions are capable of replacing and supplementing the more simple physical actions, *e.g.* evaporation and osmosis.

These conclusions are in no way at variance with Strasburger's famous experiments on dead trees.[1] In them, the water, in a tensile state, was raised by evaporation taking place at the water-surface in the permeable cell-walls.

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[1] Ueber den Bau und Verrichtungen der Leitungsbahnen.

It might appear that, in ascribing the elevation of the sap to the vital activity of the cells adjoining the upper terminations of the vascular bundles of plants, we do away with the necessity of assuming that the water of the transpiration current is in a tensile state. This, however, would be a grave error. It is evident that the effects referred to in this paper, constitute a source of *tensile* elevation only. All observations, experimental and structural, demonstrate the fact that the water of the transpiration current is *drawn*, and not *pressed*, through the capillaries forming the water conduits of plants.

The advantage of a periodic pressure in the sap, such as is observed during bleeding, has been pointed out already.[1]

CONCLUSIONS.

1. The elevation of the water of the transpiration current, when the leaves are surrounded with a saturated atmosphere, is effected by pumping actions proceeding in the living cells of the leaves.

2. The observations on the drying back of branches furnished with dead leaves renders it highly probable that these vital pumping actions are partially or wholly responsible for the elevation of water even in an unsaturated atmosphere.

3. These pumping actions are capable of raising the water against an external hydrostatic pressure.

4. In common with other vital actions, they are accelerated by a moderately high temperature, and are dependent on the supply of oxygen.

5. The cells adjoining the terminal portions of the water conduits appear to possess this activity, and, in plants provided with water-glands, the pumping actions are not limited to the secreting tissues of these glands.

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[1] Ascent of Sap., Phil. Trans. Roy. Soc., vol. clxxxvi., p. 572.

XXVIII.

REMARKS SUPPLEMENTARY TO DR. JOYCE'S PAPER ON THE OCCURRENCE OF THE NUMBER TWO IN IRISH PROPER NAMES. BY REV. T. OLDEN, D.D.

[Read DECEMBER 10, 1897.]

IT was noticed by Dr. O'Donovan that the word *da*, two, entered into the composition of many local names, and he gave instances in his Supplement to O'Reilly's Dictionary. I had found many more, and was about to bring the subject under the notice of the Academy when I found that Dr. Joyce had read a paper on it in 1868, which was published in our *Proceedings* (vol. x., p. 164). I therefore postponed my intention until I had read his essay. I was much interested in it, and particularly in his statement that he was unable to find anything in Irish literature to explain the custom, adding, "I leave to others the task of doing so."

Accepting this as an invitation to a further discussion of the subject, I now venture to offer some observations which may throw light on it.

The names compounded with *da* are both local and personal Thus we have *Ath dá én*, "Ford of two birds," which one is apt to think must refer to some local legend. But on further inquiry it is found that two birds are mentioned in so many other places that this explanation will not do. Thus we have Fortress of two birds, Ridge of two birds, Hill of two birds, and so on. Evidently, therefore, we must look for some other explanation. And the difficulty of accounting for it becomes greater when we find other animals, such as dogs, boars, horses, cranes, and ravens, appearing in twos, and, in fact, quite a zoological collection might be formed with this peculiarity.

Then there are, as I have said, personal names, such as *Colla-da-crich*, Colla of the two countries, a famous warrior of the fourth century. Dr. Joyce had collected 122 instances of these names of both the classes mentioned, and when those I had noted are added, the total is about 226. This large number makes the existence of these names the more striking, and it cannot fail to awaken a desire for information about them.

The first question is, how far back can we trace this custom. Dr. Joyce says we find it in the earliest MSS., but I think we can trace it back farther than any existing manuscript. In the fifth century, as is well known, a colony from Ireland settled in Argyleshire, and it occurred to me that if the custom existed in Ireland at that time the emigrants would probably have taken it with them, and we should find similar names there at the present day. To ascertain whether this was so or not, I wrote to Mr. Donald Mackinnon, Professor of Gaelic in the University of Edinburgh. In his reply he says, "*dá*, two, is quite common in place-names in the Scottish Highlands," and he mentioned a few names that occurred to him offhand. These are *Acha(dh)-dá-dalaich* in Colonsay, *Acha(dh)-dá-Domhnuill* in Ross-shire, *Dun dá laimhe* in Inverness-shire, *Dun-da-ramh* in Argyleshire. He most kindly offered to supply me with a list of such names, but I did not think it right to give him the trouble, as all I wanted was the fact of their occurrence.

But can we trace the custom still further back? I think we can, for we may argue in this way, if the immigrants to Scotland in the fifth century took it with them to that country, it was possible that the original settlers in Ireland in the remote past may have brought it with them from the Continent of Europe, and if so that such names might still be found abroad.

It is generally allowed that the branch of the Celtic race which settled in Ireland were the earliest of the Aryan peoples who appeared in Europe, and for this reason it is that the names of many of the permanent features of the landscape throughout Europe are of Gaelic origin, having been imposed by them.

All local names recognised as Celtic abroad are given in the "Alt-Celtischer Sprachschatz" of Alfred Holder; and on consulting this I found one which seemed to throw light on the subject. The word *Condáte*, the penultimate being long, appears to have our word *dá* as part of its composition, and this derives confirmation from the fact that the name occurs twenty-seven times in mediæval documents in France, and always with the meaning of a "confluence of *two* rivers." M. Arbois de Jubainville, however, proposes a derivation for it of a different kind. He regards it as equivalent to the Greek *σύνθεσις*, and composed of the particle *con* and +*datis*, originally +*dotis* or +*dhotis*, Greek *θέσις*, originally +*θετις*, the root being *dhe*, 'to place or lay.' I have not been able to find that *σύνθεσις* is ever applied to a confluence of rivers; but apart from this the proposed derivation is highly conjectural, and requires many assumptions, while it fails to

account for the essential feature of the name, which is the union of *two* rivers. The name in course of time became abbreviated, and appears now as *Condé*, and in German territory as Conz.

If these observations are well founded the employment of *dá* in place-names had its origin in a remote period. The earliest Celtic inhabitants must have given those names to the places referred to on their first arrival in Gaul; and as the Celtæ are found occupying their present positions at the dawn of history, the names must have been bestowed in prehistoric times. An attempt has lately been made to estimate the period of their arrival. In the second volume of Mr. Alfred Nutt's work on the "Voyage of Bran," which has just been published, he says:—"About 1000-800 B.C. began in all probability the migration of the Celtic Aryans." Taking the lowest of these figures, 800, this would assign an antiquity of between two and three thousand years to those names.

This preference for the number two appears also, as I have mentioned, in other ways, as, *e.g.*, in the case of travelled Irishmen, who were termed 'men of two countries,' no matter how many strange lands they may have visited. It appears in the tale of "The Two Sorrows of the Kingdom of Heaven," and in the list of 'pairs' of saints in the Book of Leinster. The practice seems to have continued down to modern times, and names have even been altered so as to introduce the number two. Thus Downpatrick, originally *Dun-leth-glaise*, 'The fort beside the river,' became afterwards *Dun-dá-leth-glas*, interpreted by Jocelyn, 'The fort of the two broken fetters.' So also we have *Tir-glas*, 'The land of streams,' afterwards changed to *Tir-dá-glas*, 'Land of two streams.'

There still remains the inquiry as to the origin of this usage. Why had the Celt such a predilection for the number two? When the Romans spoke of the junction of the Rhine and the Moselle, they simply called it *confluentes* (Coblentz), but the Celtic inhabitant would call it *condáte*, 'the meeting place of two rivers.' What is the reason of the difference? In considering this question we have to bear in mind the immensely remote period at which the Celts arrived in Gaul and we may conclude with certainty that they were in a very low state of culture. Professor Boyd Dawkins considers them to have been in that condition known as 'the stone age.' What this implies may be gathered from what is known of the native races of Australia, for instance. According to Mr. Tyler, the New Hollanders have no names for numbers beyond two, nor have the aborigines of Victoria. In connexion with this fact, the existence of the dual number is of

great interest. It preceded the plural, and it continued to survive with the plural for a long time; so that many languages had singular, dual, and plural—Semitic languages, as the Egyptian, Arabic, and Hebrew; and Aryan, as Sanscrit, Greek, and Gothic, as well as Old Irish. The existence of the dual can only be accounted for by its being a survival from that early period when no number beyond two was known. According to Dr. Wilson in his work on prehistoric man, "it preserves to us a memorial of that stage of thought when all beyond two was an idea of infinite number." Hence, he adds, the tendency of higher intellectual culture has been to discard it as inconvenient and unprofitable, and only to distinguish singular and plural. The earliest use af the dual was to express things which occur naturally in pairs, as the eyes, the ears, the hands; or artificially in pairs, as the horses of a chariot. When things are thought of in pairs they are regarded as a unity, and in the classical languages they may be followed by a verb in the singular. It is in this way that a pair is regarded in Ireland at the present day, and this explains the habit of speaking of one foot as half a foot, or a cow with one horn as a cow with half a horn. These are the idioms in the Irish language, the pair being regarded as a whole.

If we apply these observations to the class of names we are discussing, I think we can understand how they came into existence. Thus, to take the instance, of *snamh dá én*, that is, 'the swimming-place of two birds.' The place was probably frequented by flocks of aquatic birds, and naturally would derive its name from that fact; but our primæval ancestors had no way of expressing a number beyond unity except by the word two. Hence they called the spot the 'swimming-place of two birds,' which, translated into modern language, meant 'the place where flocks of waterfowl congregate.' So Dromahaire, or *Drum-dá-ethiar*, 'the ridge of two demons,' means 'the haunted ridge'; for the country people, far from limiting demons to two, are of opinion that the whole atmosphere is swarming with them. These considerations apply to personal names also; and it may be that such names as *Dubh-dá-crich*, 'Black haired [man] of two countries,' may be a reminiscence of that earlier black haired race which occupied these countries before the light haired Celt.

As a conquered race they were in a humble position, and it was unfashionable, therefore, to have dark hair as it is amongst the peasantry at the present day.

The Irish people, it thus appears, retained down almost to modern times a custom which had its origin in the remotest

antiquity. Elsewhere it died out, under the influence of hostile invasion and social changes; but the Irish dwelling in their island home, apart from the intellectual life of Europe, and cherishing the traditions of the past, handed on from age to age the immemorial custom of their race.

List of the Names Collected by me.

Those given by Dr. Joyce will be found in his paper above referred to. The abbreviations used are as follows :—

AFM.	Annals of the Four Masters.
M. D.	Martyrology of Donegal.
S. G.	Silva Gadelica.
M. G.	Martyrology of Gorman.
Trip.	Tripartite Life of St. Patrick. (Stokes.)
R. D.	Rennes Dinnsenchus. "Revue Celtique."
F.	Finn and the Phantoms. "Revue Celtique."

Abhainn dá loilgheach, 'River of two milch cows.' AFM.
Abhainn d'eise, 'River of two persons.' S. G. 1. 169.
Abhainn dá sailech, 'River of two sallows.' M. D. 131.
Achad dá eó, 'Plain of two yews.' AFM.
Ath dá laarg, 'Ford of two forks.' Tripartite.
Ath dáh ferta, 'Ford of two graves.' Chron. Scotorum.
Ath dá chorr, 'Ford of two cranes.'
Ath dá én, 'Ford of two birds.' Tripartite.
Bruiden dhá derga. Tripartite.
Belaeh dá liach, 'Way of two sorrows.'
Belach dá liacc, 'Way of two flagstones.' S. G.
Belach da bend, 'Pass of two peaks.' Rennes Dinnsenchus, p. 324.
Cluain dá dhamh, 'Two stag lawn.' S. G.
Cluain dá rath, 'Lawn of two forts.' AFM.
Cluain dá thorc, 'Lawn of two boars.' AFM.
Cluain dá acra, 'Lawn of two acres.' M. G.
Cluain dá fhiach, 'Lawn of two ravens.' M. G.
Cluain dá loch, 'Lawn of two lakes.'
Cluain dá andobair. M. D.
Cluain dá tharbh, 'Lawn of two bulls.' AFM.
Cluain dá chaillech, 'Lawn of two nuns.' S. G.
Cell dá les, 'Church of two forts.' M. G.
Cell dá righ, 'Church of two kings.' Wilde's "Lough Corrib, 125."

Dá charn, 'Two cairns.' Trip.
Dá bhac, 'Two round hills.' AFM.
Dún leth-glaise, 'Fort by the side of the stream.' Trip.
Dún dá-lethglas, 'Fort of two broken fetters.' M. D.
Dún dá én, 'Fort of two birds.' Reeves' "Ant.," 300.
Dún dá bheann, 'Fort of two peaks.' Reeves' "Ant.," 342.
Dún dá locha, 'Fort of two lakes.' Cath dún na-n-gedh. (*In imel Bretan.*)
Dún dá radharc, 'Fort of two views.' Smith, Hist. Cork, 1. 190.
Druim dáh dart, 'Ridge of two heifers.' M. D.
Druim dá litir. M. D.
Druim dá én, 'Ridge of two birds.' S. G.
Druim dáh mhaigh, 'Ridge of two plains.' AFM.
Druim dá léis, 'Ridge of two sheds.' S. G.
Druim da thrén, 'Ridge of two strong ones.' S. G.
Druim dén = dá-én, 'Between two waters.' Rennes Dinns., 328.
Daire dá dhos, 'Oak wood of two bushes.' S. G.
Dá charn, 'Two heaps.' Trip.
Da chích Danann, 'Two paps of Danann.' Leabhar na gCeart, 75.
Dealbhna tire dá locha, 'Delvin of land of two lakes.' M. G.
Druim dá eithiar, 'Ridge of two demons.' AFM.
Glenn dá locha, 'Glendalough.' AFM.
Glenn dá loch. Goidilica.
Glenn dá dhuille, 'Glen of two leaves.' AFM.
Glas dá cholptha, 'Stream of two shin-bones.' M. G.
Grellach dá phil, 'Miry place of two horses.' Trip.
Inis dá dhromm, 'Island of two ridges.'
Inis dá dhromand, 'Island of two backs or round hills.' Cogadh Gael re Gaill.
Inis eter dá dabull. Tigernach.
Lathrach dá arad, 'Place of two charioteers.' Trip.
Lis dá lón, 'Fort of two blackbirds.' AFM.
Loch dá dhamh, 'Lake of two stags.' Tigernach, 169.
Loch dá lig. Windisch, Wörterbuch.
Loch dá airbreach. Windisch, Wörterbuch.
Loch dá ghédh, 'Lake of two geese.'
Loch dá én, 'Lake of two birds.' S. G.
Loch dá chonn, 'Lake of two dogs.' S. G.
Loch dá ela, 'Lake of two swans.'
Loch dá ghabar, 'Lake of two goats.'
Loch dá eigeas (eces), 'Lake of two poets.' Tigernach 3rd, 152.

Magh dá chairneach, 'Plain of two priests.' AFM.
Magh dá chlaoine, 'Plain of two sins.' AFM.
Magh dá chonn, 'Plain of two dogs.' AFM.
Magh dá ghabhul, 'Plain of two forks.' AFM.
Magh dá ghabhor, 'Plain of two goats.' AFM.
Magh eter dá glas, 'Plain between two streams.' AFM.
Magh dáh gés, 'Plain of two *tabus*.' Windisch.
Magh dá eó, 'Plan of two yew trees.' Finn.
Oilean dá chruinne, 'Island of two round hills.'
Oilean dá bherrach, 'Island of two heifers.' Tigern., 246.
Ros dá charn, 'Wood of two heaps.' AFM.
Ros dá chorr, 'Wood of two cranes.'
Rinn dá bharc, 'Point of two ships.' S. G.
Sliabh da chon, 'Mountain of two hounds.' AFM.
Sliabh dá én, 'Mountain of two birds.' AFM.
Snamh dá én, 'Swimming-place of two birds.' Trip.
Tir dá ghlass, 'Land of two streams.' AFM.
Tir ghlass. Trip., 206.
Tuaim dá bhodhar, 'Tomb of two deaf men.' HFM.
Tuaim dá ghualann, 'Tomb of two shoulders.' HFM.
Tir dá chraebh, 'Land of two trees.' M. D.
Tir dá locha, 'Land of two lakes.' S. G.
Traigh dá bhan, 'Strand of two women.'
Tulach dá each, 'Hill of two horses.'
Tulach da roth, 'Hill of two wheels.'
Tuath dá mhuighe, 'Land of two plains.'

(*Personal appellations.*)

Colla dá chrich, 'Colla of two countries.'
Dubh dá bhoirenn, 'Dark man of two rocks.' S. G.
Dubh dá chrich, 'Dark man of two countries.' Tigern., 241.
Dubh dá dhét, 'Dark man of two teeth.'
Dubh dá dhoss, 'Dark man of two bushes.' Tigern., 246.
Dubh dá lacha, 'Dark man of two ducks.' Tigern, 246.
Dubh dá leithi, 'Dark man of two portions.' 396.
Dubh dá tuath, 'Dark man of two territories.'
Dubh dá inbher, 'Dark man of two estuaries.'
Fer dá liach, 'Man of two sorrows.'
Fer dá chrich, 'Man of two countries.' 396.
Fer dá loch, 'Man of two lakes.'

Fer dá leithi, 'Man of two territories.'
Mac dá cherda, 'Son of two arts.'
Mac dá thó, 'Son of two mutes.' Trip.
Mae dá chreach, 'Son of two plunders.' Finn.

IN ENGLISH.

Two pot House. Parish of Buttevant.
Two pot House. Castlelyons.
Two mile-river Bridge.
Two mile Bridge.
Two mile Borris.
Two mile Ditch.
Two rock Mountain.

NOTE ADDED IN THE PRESS.

The frequent occurrence of the appellation *dubh*, black, attached to the names of prominent ecclesiastics and others, suggests the probability that they were members of the black-haired race which preceded the Celts in Ireland, and were believed to be intellectually superior to them.

As regards the final syllable of Con-da-ti, it would appear to be a primitive river name, which, according to Holder's "Sprachshatz," is *iti* in Old Slavonic and *éiti* in Lithuanian. It occurs in the name of the Itis which falls into the Sound of Sleat, Ptolemy's ἴτιος, εἴτιος (genitive), cf. Loch *Etive;* in the Itta, now the Epte, which joins the Seine at Givernay; and in Ptolemy's Αργ-ίτα, the Bannin Ulster, also the river Tees.

XXIX.

ON THE ROUND TOWER OF CHAMBLES, NEAR FIRMINY, DISTRICT OF ST. ETIENNE (LOIRE). BY PROFESSOR J. P. O'REILLY, Royal College of Science, Dublin.

[Read JANUARY 24, 1898.]

HAVING become interested in the examination of some details of construction presented by the round towers of Ireland, I was led to seek for information bearing on the matter, in the authors who have most authoritatively treated the question of their structure and origin, more particularly in the works of Petrie, O'Brien, and O'Neill. The study of them led me to regret that their works had not been preceded by a complete and detailed description of all that remains of these very interesting monuments. Petrie, towards the end of his memoir, promised to undertake and have published such a description; but nothing has been done to fulfil this promise up to the present. To any one taking an interest in the question, and wishing to push investigation to definite limits, this want is very distinctly a hindrance, so serious, indeed, as to bar all further prosecution of the study. No effective comparison of the details of the construction of the different towers is possible without the aid of such a complete description of them, and all safe conclusions as to their origin and object must to a large extent be based on such a comparison. At present photographs are procurable of many of the towers; but no complete collection of such photographs has yet been published. Did it exist, and were it accessible to the public, those taking an interest in the question, would have means of investigation furnished them sufficient to form a basis for sound and accurate study. It must be borne in mind that O'Neill has called in question the correctness of certain of Petrie's drawings, and that these, however excellent the artistic work may be, are not always drawn to scale.

In working out his conclusions as to the origin and object of the round towers, Petrie makes mention[1] of the curious reference in

[1] Trans. R. I. Acad., vol. xx., p. 376.

Mabillon's "Iter Germanicum" to a pharus or beacon tower at the Irish monastery of St. Columbanus at Luxovium, now Luxeuil, in Burgundy, and which, he says, seems to give some support to the conclusion—"I have thus hypothetically advocated that they (the towers) may very probably have also been occasionally used as beacons and watch towers."

Evidently had he known of the existence of any other such towers on the continent of Europe, or elsewhere, he would have been led to consider them, and examine the bearing that their details of construction and their history, might present on the views he was advancing as regards the Irish round towers. *A priori*, it might have been presumed, that some such towers did or even do exist, since, from whatever point of view they may be considered, the presumption would be that they were the work of a foreign people, that is of some one of the colonies or peoples which, tradition tells us, arrived in Ireland at various remote periods of the history of this country.

Having these ideas in mind, but not keeping them directly in view, I attended the Annual Congress of the French Association for the Advancement of Science, which was held, in the first half of August, at St. Etienne, in the Department of the Loire, in no way expecting, or even thinking, that anything would present itself cognate with the question.

As is usually the custom on such occasions, the committee of reception not only published a full description of the district, from every point of view, but there was also prepared a small handbook, with illustrations, indicating summarily the various localities of interest accessible to excursionists. One of these at once struck me as presenting the outline of a round tower, such as frequently occur in this country. To my inquiries for further details as to the nature of the building, I could get no satisfactory reply, and consequently I determined on assuring myself whether there was any justification for my reading of the sketch or not. The point indicated, Chambles, is easily accessible from Firminy, which is a mining centre, and in connexion with St. Etienne by a steam tramway, as mentioned in the guide-book; but not wishing to wait for hours at the railway station of Firminy, I took a trap, and had the advantage of seeing the country and having a view of Chambles, which I would not have enjoyed from the railway.

The village is very old, though, singularly enough, it is not mentioned in the remarkably compendious Geographical Dictionary of Vivien de St. Martin, recently published, nor in the supplement to that

work, still in course of publication. It is situated about 4½ miles, north-west by north, from Firminy, on one of the spurs of the hills of granite and mica-schist, through which the Loire has in this locality cut its valley, and which render its course so winding and so picturesque. It overlooks the river from a height of about 300 to 400 feet, commanding in one direction a view up the valley of the river towards the south,

and in the other an extended view over the Forez plain. The tower in question is situated at the western end of the spur, where it joins the hill, and within about 100 yards of the main road. It stands quite detached from any building, on a platform surrounded by a low wall on the north and north-west sides, and in the immediate vicinity of the village church, but at a level of some few feet higher than this.

This church is approached from the lower level of the narrow streets forming the village by a broad flight of about twenty steps, and is a low, building, without much indications of style, and having a rather flat, tiled roof. The tower stands at the north-west corner of, and at about 8 to 10 feet from, the nearest point of the church, but, as remarked, it stands quite alone. I was able to take the circumference of the tower at the base, or rather level of the ground, and to estimate the heights and widths of the different parts of the structure sufficiently for a general description, and while awaiting more accurate measurements which I have reason to hope will be made available. While engaged in examining the tower, the Curé happened to be in the church, and kindly brought me the key of the lower door, explaining to me at the same time, quite spontaneously, that this door was not part of the tower as it originally stood, and was relatively recent, as is indicated by its structure, its dimensions, and the state of the surrounding masonry. What at once struck me was the situation of the original doorway, at about 15 feet above the lintel of the lower door, its trapezoidal and narrow form, contracting from the bottom to the top, and the shape of the lintel so like in outline certain of the doors of the round towers figured by Petrie and others. This door looks about south-east; at the same level, and on the western side, a half turret projects from the side, the bottom part of which is formed of two stones cut away on the line of junction so as to leave a sort of V-shaped void, by which, therefore, communication could be had with the ground. The top part was battlemented, the principal part of the battlements still remaining as indicated by the sketch. The roof was flat, or practically so, and the rain was drawn off by gargoilles, two of which are shown. These details occur in certain of the Irish round towers, notably at that of Kells.

What further struck me as remarkable are the square holes which extend at intervals of about 6 to 7 feet more or less regularly from top to bottom, and which have about 8 to 10 inches in section; that is about the height of the courses of masonry. These holes are thorough so far as ascertained. The masonry is in courses of dressed granite, having a variable height of about 8 to 10 inches. The mortar has, in the lower courses at least, a thickness of nearly 1 inch in places. So old is the building that both the granite stones and the mortar have been much eaten away, so much so that the stones appear quite rounded, and that to an extent difficult to render in a sketch. There are two small windows or loop holes at about the level of the lintel of the original door, and looking east and west, but not figured on the

drawing. The view from the top of the tower must be very extended and commanding. In the interior I was able to note that the lower part is vaulted at the level of the threshold of the original door, and that a communication exists between this lower part and the upper portion through a square hole. I was also able to note that the roof of the tower is also apparently vaulted. There is a somewhat similar tower at about a half-a-mile distance in the direction of the Forez plain, but I had only a view of the summit as it projected above the outline of a neighbouring hill.

On my return to St. Etienne I sought out any further information obtainable regarding this tower, and have to thank Monsieur Jos. de Freminville, Archiviste Départmental de la Loire, and Monsieur Noël Thiollier, Archiviste Palæographe (the author of the little excursion guide book) who very kindly placed at my service the information immediately accessible relative to the tower. This is known in the country as the "Tour noire de Chambles." I was shown the paragraph concerning the village in the remarkable work in 2 vols., folio, by Mr. Felix Thiollier, "Le Forez Pittoresque et Monumental," which contained about as much as is known relative to the place and its monuments, but which does not furnish much detail of any consequence as regards the tower. On calling the attention of these gentlemen to the points of resemblance, which the tower presents with those of Ireland, and in particular as regards the position and form of the door, they seemed struck by my observation, and at my suggestion, agreed that it would be desirable to have the building measured in its various details and described. For these details we must wait before any final judgment is come to as to the exact designation of the monument, but from what is contained in the present brief notice, it can be recognized that the building presents certain characteristics and details of structure, which connect it with the round towers of this country, and that consequently it may serve as a term of comparison for their more perfect study. Messrs. de Freminville and Thiollier remarked that a more careful search in the country would probably bring to light the existence of other towers of this sort, and thus furnish further terms of comparison from the Continent, and more particularly from the valley of the Loire, which formerly was the high way by which merchandise and traffic passed from the Mediterranean to these islands. These gentlemen further informed me that Chambles was the site of a Celtic Oppidum, and that remains had been found there attesting this. The general aspect of the village, and the manner in which the church and tower are surrounded partly by a wall and

partly by a narrow roadway, deeply cut in the rock, point certainly to great antiquity, and render it well worthy of a very careful study by archæologists. The following are the principal dimensions so far as could be ascertained :—

	ft.	in.
Circumference at base, - - -	58	0
Diameter (exterior), - - -	18	6
Thickness of wall at ground, - -	4	10
Diameter (interior), - - -	8	10
Height of original door from ground, -	22	0
Height of door from sill to lintel, -	8	0
Width at sill, - - -	2	3½
Width at lintel, - - -	2	0
Total height of tower, - - -	49	0

In consequence of some remarks of mine when in conversation with the gentlemen above mentioned as to the age attributed to the round towers of Ireland, and the possibility that this tower might have a corresponding age, which remarks were more or less correctly expressed and understood, and so reached the ears of Monsieur L'Abbé J. Prajoux, of St. Paul en Cornillon (Loire) who was interested as an antiquary in the question of the age of the Tower of Chambles, I received from him a letter asking me to be good enough to acquaint him with the reasons I had for assigning the eighth century as that of the building of this tower, and informing me that in the opinion of the archæologists of the Department of the Loire it is estimated as being of the eleventh or twelfth century, and that it belonged to a *military* system of defence connected with the wars of the Archbishops of Lyons with the Counts of Forez. I replied, explaining that I did not pretend to judge the question of its age in any way. I stated the age or ages usually assigned to the round towers of Ireland, and mentioned the great interest presented by a structure having so many points of resemblance with these monuments whose history and uses it might assist in more clearly elucidating than had been possible up to the present.

Note added in Press.

Since the communication of my Paper to the Royal Irish Academy, I have received from the Abbé J. Prajoux referred to therein, a copy of his recent publication, "Notes et Documents sur Chambles," Lyon & St. Etienne, 1897, forming part of a series

"Etudes historiques sur le Forez," and containing much valuable and interesting historical matter on Chambles.

At p. 8, Section IV., it is stated:—

"Les fortifications de Chambles furent construites dans le courant du XIII^e siècle. Elles étaient formées de plusieurs parties distinctes. Au centre se trouvaient le château seigneurial et l'église: il reste encore de cette partie la haute tour cylindrique qui domine le village, les bases de l'abside ainsi que les restes des murs qui entourent ces constructions."

The following description of the tower is given at p. 29:—

"Le donjon est actuellement la partie la plus ancienne et la plus intéressante des ruines de Chambles. C'est une haute tour cylindrique qui a 18 mètres de circonférence; sa hauteur égale sa circonférence. Elle est construite en pierres du pays et paraît remonter au XI^e ou au XII^e siècle, comme la plupart des châteaux fortifiés de notre région. A dix ou douze mètres du sol se trouve une étroite porte carrée, régulièrement percée, et juste suffisante pour donner passage à une seule personne. Elle était ainsi placée pour qu'on ne pût y pénétrer sans la volonté de ceux qui s'étaient réfugiés dans la petite chambre voûtée à laquelle elle donne accès. De cette chambre, une ouverture carrée, pratiquée au milieu de voûte, conduit à la terrasse supérieure; au-dessous, une autre ouverture également carrée et faite dans le pavage, solidement assemblé, permet de descendre dans une pièce inférieure placée à la hauteur du sol; c'était autrefois le seul accès possible. On y arrive aujourd'hui par une ouverture pratiquée en forme de porte dans l'épaisseur de la maçonnerie; mais ce passage n'a été ouvert que dans les premières années de ce siècle.

A peu près à la hauteur de la porte, se trouve, en saillie sur le mur, mais soutenu par un encorbellement, un petit avant-corps demi-circulaire et peu élevé, qui pouvait servir de poste d'observation.

Les murs de cette antique construction, de laquelle on avait exclu le bois pour qu'ils fussent à l'épreuve du feu, ont un mètre quarante centimètres d'épaisseur. En l'absence de documents authentiques, il est difficile de dire aujourd'hui l'âge de cet édifice. Les archéologues l'attribuent à cette époque qui va du VIII^e au XII^e siècle. Espérons que l'archéologie et l'histoire nous donneront bientôt la solution de ce problème!

XXX.

REPORT ON THE EXCAVATION OF TOPPED MOUNTAIN CAIRN. By THOMAS PLUNKETT and GEORGE COFFEY.

[Read 24th January, 1898.]

Topped mountain is situated about five miles east of Enniskillen, Co. Fermanagh (Ordnance Map, sheet 23).[1] It is a dome-shaped hill, somewhat isolated from its neighbours, and rises to a height of 909 feet above the sea-level. The summit commands a wide-reaching view of the surrounding country. On the west side the upper and lower lakes of Lough Erne are extended at the spectator's feet. The cairn which crowns the summit of the hill is symmetrically formed in the shape of a truncated cone. It measures about 90 feet in diameter at the base, and 50 feet at the top, and averages about 12 feet in height. It is locally called "the moat." At the centre of the flat top was, as is frequently the case in such cairns, a small depression about 6 feet in diameter by 2 feet deep. The cairn has been a favourite station for bonfires, and whether the depression has been made by treasure-seekers or by the bonfire-makers, or is an original feature, it would be impossible to say. In a cairn excavated by Mr. Plunkett the previous year on Belmore mountain, a similar depression, locally called "the Eagle's Nest," appeared in his opinion to have been artificially lined with stones.

The excavation of the cairn was begun on the 30th June, and continued, with the exception of two days, to July 10th. Eight labouring men were employed on the first day, and ten to eleven men on the subsequent days. In the first instance a face was cleared at the east side, which was carried round to the south side as the work progressed. The excavation was pushed in well past the centre; in fact the entire body of the cairn was excavated to the ground level with the exception of the outer slope of the mound on the north-west side, which it was thought undesirable to disturb, so as to preserve the outline of the mound as a feature in the landscape. In plan, fig. 1, the dotted line shows the extent of the excavation.

The cairn proved to be formed chiefly of slaty stones with a

[1] See Paper by W. F. Wakeman, Jour. R. Hist. Arch. Assoc. Ireland, 4th Series, Vol. 3, p. 529.—Ed.

considerable admixture of clay. It was very damp in most parts, there being little drainage from the peaty under-soil.

Within a couple of hours from beginning work the cap-stone of a cist was reached at a point about 5° north of east, and about 10 feet in from the margin of the cairn. The grave lay north and south (A on plan). The cap-stone was carefully slid off, and the contents of the grave exposed. The cist of this grave was not, as is usually the case, formed of large stones. The cairn showed at the back, above the cist,

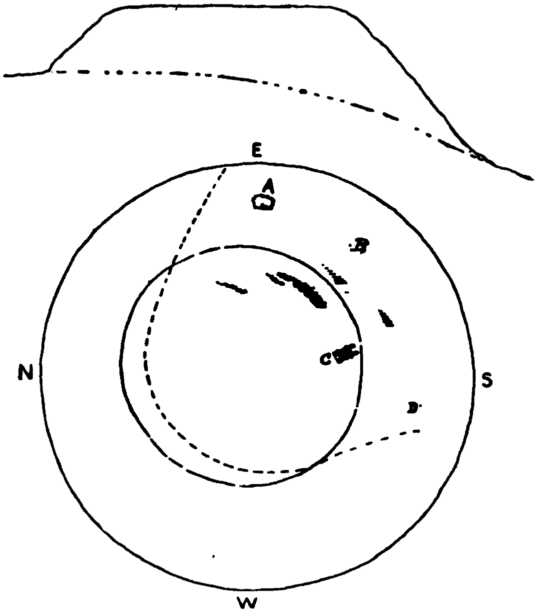
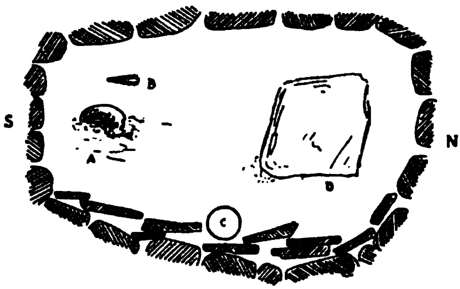


FIG. 1.—Plan and elevation of Cairn.

some appearance of facing, and the interment presented the appearance of a secondary burial inserted in the cairn subsequent to the erection of the latter. The cap-stone rested at the back on the stones of the body of the cairn, and was, as it were, let into the cairn some 2 feet. The supports at the outer side were rudely built up of the average stones of the cairn. The bottom was flagged with small flag-stones, and at the outer side a number of small flag-stones were set on end so as to form a sort of lining to the grave.

The stones supporting the cap-stone were built up outside the lining stones. Thus, when opened, the grave had the appearance of

being sunk about a foot, and lined inside the bearing stones on the outer side. (See accompanying plan.)



Plan of Grave.

The inside measurements of the cist were:—Length, 4 feet; breadth at middle, 2 feet 6 inches; height, 2 feet. Cap-stone, 5 feet by 3 feet 6 inches by 1 foot. At the south end a smaller cap-stone was placed where the large stone did not quite cover the cist. The bottom was covered with clay, and was very damp. This rendered the examination of the contents of the grave somewhat difficult.

At the south end were the much decayed fragments of a skull. About the middle were a few fragments of long bones. At the right side of the skull lay the bronze dagger (fig. 2), the point to the south. In the same place was found a small band of gold (fig. 3). It appears to be half of a band of that metal that was probably round the handle of the dagger. Though careful search was made, no further fragment of this gold band was found. At the left side of where the body would have lain (C on plan of grave), were the fragments of a richly-decorated urn of the "food-vessel" type (fig. 4). It had suffered greatly from damp, but the upper part, bottom, and portions of the sides were recovered, and have been put together with sufficient completeness to show the form and decoration.

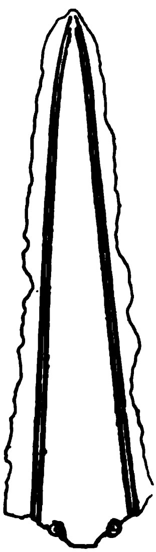


FIG. 2 (½ size).

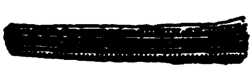


FIG. 3 (full size).

At the north end of the grave lay two thin flag-stones, one over the other, the largest about 18 inches in longest dimensions. On lifting these, a heap of cremated bones, reduced to small fragments, was discovered on the clayey bottom of the grave. An examination disclosed portions of upper and lower human jaws and fragments of a cranium. This establishes the fact that the cremated remains were not portion of the body represented by the skull at the south end.

FIG. 4.—Urn, partly restored: height, 14·2 cm.; diameter at mouth, 15·5 cm.; at base, 7·5 cm.

The dagger can be associated with certainty with the unburnt interment. The fact that the burnt bones were not enclosed in an urn, but apparently deposited without any special care, when contrasted with the rich decoration of the food-vessel, leads to the conclusion that the urn is also to be associated with the unburnt interment.

Urns of the type of the present one have usually been found in Ireland with cremated interments, and it is just possible that the bones were enclosed in a larger urn, which, as the large urns are generally imperfectly baked, has completely perished. No indications of such an urn were noticed in the clay on which the bones rested. The two flag-stones which lay on the top of the bones may, however, have been originally set up against each other to protect the interment, and have fallen afterwards. The positions of the objects found are marked on the plan of the grave.

Thirty feet south of the cist, on the same circumference, was found a deposit of burnt bones, protected by two small flags placed Λ-wise: marked B on plan of Cairn.

The following day (*July* 1*st*), the excavation was continued behind the cist, when a large stone such as might be used for the side support of the cist was uncovered at about 4 feet behind it. Traces of charcoal were found here, and a well-worked flint scraper, also a flint flake, but nothing in the nature of an interment. Charcoal was also found at the south end of the excavation, and then a large patch of charcoal and unctuous clay at the centre of the excavation. A second worked flint scraper was found about this spot. The segment excavated was worked in to about 15 feet from the centre of the cairn, during which traces of charcoal were found at intervals showing fragments of burnt sticks, but no traces of bones of any kind.

July 2*nd*.—A fresh excavation was made at the south side, and worked to meet the first excavation. The face cleared was thus extended from about 10 feet north of the east point round to the south side of the cairn. Traces of charcoal were again found at intervals, and a flint flake at the south end of the excavation at a depth of 10 feet from the top of the cairn.

July 3*rd*.—At the south-east, 10 feet from the centre, and at a depth of 6 feet, accompanied by traces of fire, were found a fragment of burnt bone and a flint chip. The centre was reached on this day. The construction here was curious; the stones at each side were more or less on end, leaning inwards in this form—Λ. This construction suggested that it might have been intended to relieve the weight on a chamber below. But on clearing the face to the ground level, no chamber was discovered, and the apparent construction at the centre was probably caused by the sliding down of the small flag-stones at the sides as the cairn was being heaped up.

July 4*th*.—Excavations continued without results. As on previous and subsequent days patches of charcoal and burnt clay were found

at intervals at depths of from about 4 feet down to the bottom of the cairn.

July 6th.—The face of the excavation was cleared along the central line to a depth of 16 feet at the centre. At the south end a number of large stones were disclosed, placed on end, with two cross stones, the whole arranged as on plan (c). Between the two innermost upright stones a small flag-stone was placed on which remains of burning, charcoal and burnt clay, were found. Similar evidence of burning was found in the central cist-like enclosure, but no certain evidence of any interment. No covering stones were found in connexion with this structure.

July 8th turned out wet, and work was stopped.

July 9th.—The excavation was continued past the centre. At a distance of 8 feet past the central line, and a depth of 10 feet from the top of the cairn, burnt matter and charcoal was found on a flag-stone, protected by a couple of upright flags. In this spot a few minute particles of burnt bones were found, and a few small fragments of pottery. A few particles of burnt bones were also found at some distance east of this spot; also a few particles of pottery.

The fragments of bones in these cases were quite soft, resembling small pieces of lime in the wet clay, but in a few instances they could be identified as burnt bones by the characteristically cracked surfaces of the fragments. The pieces of pottery were soft and soap-like. They did not show any traces of ornament, and resembled more the plain sort of pottery found in the sand-hills of the north of Ireland than sepulchral pottery, but the fragments were too small to speak of positively.

July 10th.—The excavation of the cairn, as far as was considered desirable, was concluded on this day. At the south side, about 4 feet in from the slope, a deposit of burnt bones and a stone celt were found (D). Mr. Plunkett, who alone was present at this find, thus describes it:—The burnt bones lay on a small flag-stone, with charcoal matter, as in former cases. If protecting stones had been placed around the deposit, they had apparently been crushed down by the weight of the overlying stones, as no indication of such was seen. Among the bones and matter adhering to the flag was found a small stone celt. It is somewhat flat and thin in make, in perfect condition, the edge quite sharp (fig. 5). The stone is an amygdaloidal porphyrite.

Bonfires have frequently been lighted on the top of the cairn; and it is possible that some of the charcoal found in the cairn has been

carried down through the stones, and stratified by rain-water. This might account for some of the upper patches of charcoal, but not the lower, and especially the larger spots. The latter are, no doubt, burial, or associated with burial. It may be inferred from the fact that the particles of burnt bones and pottery found, in at least two cases, were reduced by wet to little more than traces; that, in some of the other cases, the bones and pottery have been completely washed

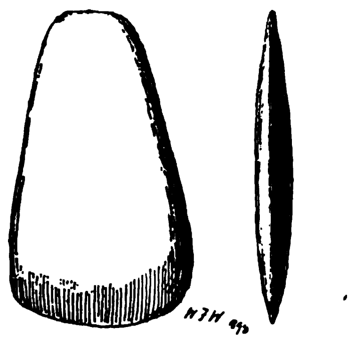


FIG. 5.—Stone Celt (½).

away. In the case of the deposit of bones marked A on plan, the part of the cairn in which they were placed was comparatively dry, which would account for their better preservation. It is somewhat perplexing, considering the importance of the mound, that, with the

Fig. 6.—Cranium (Front).

Fig. 7.—Cranium (Profile).

exception of this instance and those mentioned on the 6th and 8th July, nothing in the nature of a cist, or protecting stones, were found.

Dr. C. R. Browne has examined the human remains found in the grave first-mentioned. He writes that the cranium is evidently that of an adult male, but it is unfortunately too fragmentary to admit of any measurements of value being obtained. Some idea of its type may be had from the annexed copy of a photograph, which, when more work has been accomplished in Irish Craniology, may enable it to be classified.

It must be mentioned that the profile view (fig. 7) appears somewhat flatter than what it actually was, owing to the fact that the parietal fragment of the left parietal bone is not perfect to the median line, but falls short thereof by about a centimeter and a half. This will be seen in fig. 6 from a photograph of the *norma facialis*.

XXXI.

ON A CAIRN EXCAVATED BY THOMAS PLUNKETT, M.R.I.A., ON BELMORE MOUNTAIN, CO. FERMANAGH. By GEORGE COFFEY.

[Read January 24, 1898.]

During a visit to Mr. Plunkett, at Enniskillen, in July, 1897 (when the cairn on Topped Mountain was excavated) he very generously placed in my hands, for presentation to the Museum of the Royal Irish Academy, the important collection of objects obtained from a cairn on Belmore Mountain, which I have the honour to exhibit at this meeting.

The following particulars of the excavation of the cairn were taken down by me from Mr. Plunkett, and are given in his words:—

"The cairn is situated on an eastern spur of Belmore Mountain overlooking the valley of the Erne, in the townland of Moylehid or

Fig. 1.—Section of Cairn.

Moyleid[1] (Ordnance Sheet 26). It was not recognised to be an artificial mound by the people of the district, or even by antiquaries. It resembled some of the natural bosses of cherty limestone, overgrown with peat, which occur on that part of the mountain. A circular

[1] Mul-leitheid. See Joyce, "Irish Names of Places" (Sec. Ser.), p. 394.

depression in the centre of the mound, locally called the "Eagle's Nest," was the only name attached to the cairn. The cairn was about 40 feet in diameter and 10 feet high.

"Having obtained permission from Mr. Leslie and Mr. Lennon, the owners of the land, I proceeded to excavate the cairn in November, 1894. Four men were employed, and the work of excavation occupied four days. The ground at the eastern side of the cairn fell rapidly,

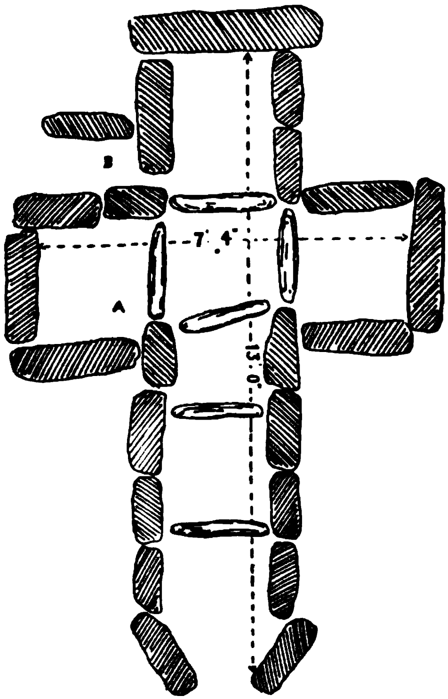


Fig. 2.

which facilitated the excavation at that side, the stones, as cleared out, being rolled down the slope of the ground.

"Following up the opening at the east point, at about 6 feet from the margin and 2 feet above the surface of the ground, a rude cist was found, consisting of three small flag-stones, two of which were placed Λ-wise and rested on the third, which formed the bottom. In this cist were found the unburnt remains of a child, consisting of the skull and some of the long bones. Along with the bones of the child were

the bones of a bird, about the size of a plover. The latter crumbled when exposed to the air, and the species was not determined.

"A few feet farther in, large limestone flags, much weathered, were reached. These formed the right arm of a cruciform passage and chamber grave of typical form. It was then found more convenient to make a new opening along the axis of the passage and follow up

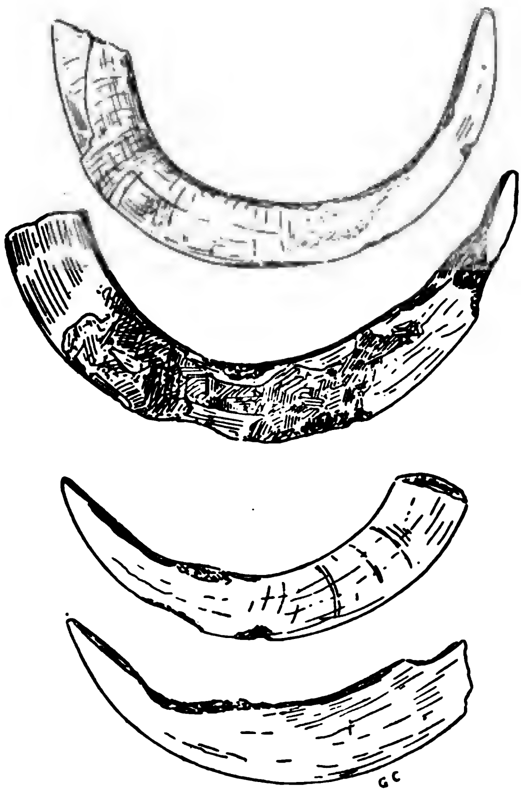


FIG. 3.—Boars' Tusks.

the compartments of the passage and the chambers in succession. The bearing of the passage was approximately south-east (see fig. 1). When three feet of the talus was removed on this new line of excavation, the passage was reached. It is worthy of remark that no covering stones were found on the passage, or on the head and side chambers, with the exception of the left-hand chamber.

"The first compartment in the passage measured 2 feet 10 inches long by 2 feet 4 inches wide. The two first stones were turned in, half closing the entrance (see fig. 2). The stone at the back is a sort of division or sill stone about 1 foot high. The other compartments in which the passage is divided, were more or less similar to the first; their dimensions are shown on the plan. The side stones and chamber stones range from 2 to 3 feet in height. The contents of the passage and head and right arm chambers consisted of a mass of burnt bones, on the top of which the stones of the cairn had been apparently filled in without any constructional arrangement. The burnt bones were taken out in shovel-fulls, spread out and allowed to dry, then searched. The beads and pendants here figured (fig. 6) were picked out from among the burnt bones, so spread out, but it is not possible to say whether they came from any particular compartment or chamber.

FIG. 4.—Urn: height, 9·75 cm.; diameter at mouth, 12 cm.; at bottom, 10 cm.

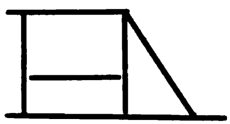
"As the excavation proceeded, to the right of the second compartment of the passage, a small cavity was found in the face of the cutting at a height of about 4 feet from the ground level. A small flag formed the bottom of this cavity, and the contents were protected by a few large stones. In this rude cist were found the unburnt remains of a second child, and with them portion of a rib bone, apparently of an ox.

"The left arm chamber was covered by a slab. This arm proved to have two stories, a second chamber being built over the flag covering

the lower one. The lower chamber contained a human skull placed on its base, and some other human bones, unburnt, but apparently not a whole skeleton. Along with the human bones were bones of deer, pig, rabbit, and some bird. Also several remarkably large boars' tusks (see fig. 3), and a few sea shells.

"The upper chamber contained an urn (figure 4), and burnt bones. No burnt bones were, however, found in the urn. No beads, flints, or other objects were found with this interment. The urn has lost the bottom, but it was little deeper than shown, as the beginning of the turn of the bottom can be seen at one place on the inside.

"Outside the lef tarm in the outer angle, between it and the head chamber, a rude secondary chamber was found, constructed as a lean-to, formed by a slab leaning towards the side stones of the left arm chamber, and closed at the top by a smaller stone (see plan). In this chamber were found a second human skull placed, like the first, on its base, and human bones, also animal bones similar to those with the previous skull, including some large tusks of the boar.



"The chambers at the head of the passage and at the right-hand side, as already mentioned, contains nothing but burnt bones. Just as the head chamber was uncovered the stones fell down from the face of the cutting, and disclosed a well-formed cist in the face of the cutting near the top of the mound (see section, fig. 1). Its dimensions were 2 feet 4 inches long by 1 foot 8 inches at the wider end (the east), and 1 foot at the narrower end. It lay east and west. The cist contained burnt bones, and in the right hand corner at the east end was found a richly decorated bowl-shaped urn (fig. 5). No burnt bones were found in the urn, but in the bottom of the vessel was a greasy, black, pasty substance.

"It is interesting to note that the excavation showed that the peat had grown over the cairn to a depth of five feet at one side, and was of a dark compact appearance. Underneath the peat that covers the mountain, limestone boulders abound, but the peat on the knoll where the cairn is placed is not deeper than on the cairn itself, from which it may be inferred that the peat has been formed since the cairn was erected."

Unfortunately on the day the skulls were discovered, Mr. Plunkett took a severe chill and had to leave the mountain. The skulls were left behind, and when some days afterwards he returned only

fragments could be found. One lower jaw and a portion of another lower jaw only have been preserved.

The animal bones and shells preserved by Mr. Plunkett have been submitted to Dr. Scharff. He has identified the following:—Irish hare (portion of pelvis, two vertebræ, one femur, and several incomplete bones); goat (horn cores); piece of ulna of a large bird, species

Fig. 5.—Urn: height, 9·5 cm.; diam. at mouth, 11·25 cm.; at base 6·25 cm.

not determined; shells, *Pecten maximus* (fragment), *Pectunculus glycimeris* (several).

The boars' tusks are of exceptional size, and are probably the largest as yet recorded from Ireland. There are five complete, or nearly complete, tusks (three right, two left), and five fragments.

The latter belonged to at least four separate tusks (two right, two left). The dimensions are as follows:—

	Length on outside of curve.	Width at base.
1 Right, . .	21 cm. . .	2·5 cm.
2 ,, . .	20·25 cm. . .	2·1 cm.
3 Left, . .	14·25 cm. . .	2·3 cm.
4 ,, . .	,, . .	2·1 cm.
5 Right, . .	,, . .	,,
Fragments:—		
1 Right, . .	— . .	2·5 cm.
2 Left, . .	— . .	2·3 cm.
3 Right, . .	— . .	2·1 cm.
4 Left, . .	— . .	,,

The fifth is the point of a large tusk and may be the point of No. 1, with which it agrees in colour and texture. The first four tusks are illustrated at half linear size, fig. 3. The two lower, Nos. 3 and 4, as also No. 5 not figured, have lost portions of the root end: they were originally about the size of the complete tusks, Nos. 1 and 2.

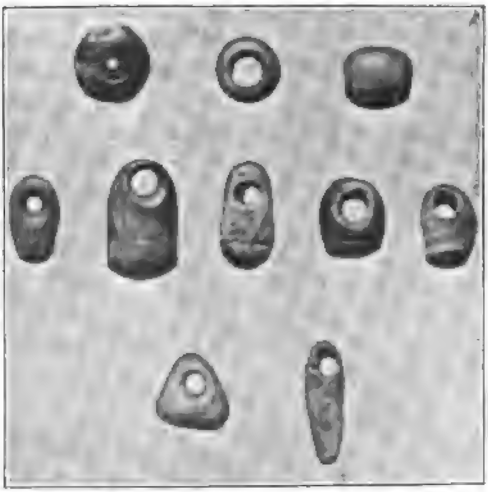


FIG. 6.—Beads and Pendants (three-fourths of full size).

The beads and pendants are of considerable interest. There are three beads, one of which, the first, fig. 6, is a small carnelian pebble.

It is rubbed down in places so as to bring it to a rudely globular shape. The hole is widely splayed. The remaining beads and pendants—with one exception, the last, a tooth—are of soft silicious stone apparently allied to serpentine. One of the beads has been much altered by fire. The pendants are seven in number. The largest is plain, but well formed and highly polished. A smaller, also plain, is more curved in outline. Three have an incised line or nicking cut round the lower part. Two of these have suffered much from burning. One, plain, is triangular. The remaining one appears to be the tooth of an animal worked and pierced. The species has not been determined.

The beads and pendants are very similar to those obtained from the Loughcrew cairns.

In type, the cairn and chambers on Belmore mountain are likewise similar to several of those on the Loughcrew hills, with the exception that there was no curb of large stones around the base of the cairn on Belmore mountain. The absence of covering stones for the passage, and with one exception the chambers at Belmore mountain, has been noticed. The absence of covering stones has been also observed in the smaller cairns at Loughcrew

About 150 yards below the cairn are the remains of a circular lis or fort formed of loose stones. It is marked on the Ordnance sheet. The cairn would appear to have been associated with this station or settlement.

XXXII.

AMENDMENT TO "THE TWELFTH AND CONCLUDING MEMOIR ON THE THEORY OF SCREWS": TRANS. R.I.A., Vol. XXXI., pp. 145–196. BY SIR ROBERT BALL, LL.D., F.R.S., Lowndean Professor of Astronomy and Geometry at Cambridge.

[READ April 25th, 1898.]

I HAD occasion to set down, on page 172 of the above-mentioned Paper, a construction for the three double points of two plane homographic systems. It is no doubt true that the three double points possess the property there stated, but the converse does not generally hold, as I had incautiously supposed. The construction given is therefore unsound.

A correct construction for the double points of two homographic systems of points in the same plane is as follows:—

Let O and O' be a pair of corresponding points. Then each ray through O will have, as its correspondent, a ray through O'. The locus of the intersection of these rays will be a conic S. This conic S must pass through the three double points, and also through O and O'.

Draw the conic S', which is the locus of the points in the second system corresponding to the points on S, regarded as in the first system. Then since O lies on S, we must have O' on S'. But S' must also pass through the three double points. O' is one of the four intersections of S and S', and the three others are the sought double points. Thus the double points are constructed.

On the same page (*loc. cit.*) I also set down a construction for the four double points of two homographic systems in space. Here again the process is not generally applicable. I replace it by a correct construction, as follows:—

Let O and O' be two corresponding rays. Then any plane through O will have, as its correspondent, a plane through O'. It is easily seen that these planes intersect on a ray which has for its locus a quadric

surface S, of which O and O' are also generators. This quadric must pass through the four double points.

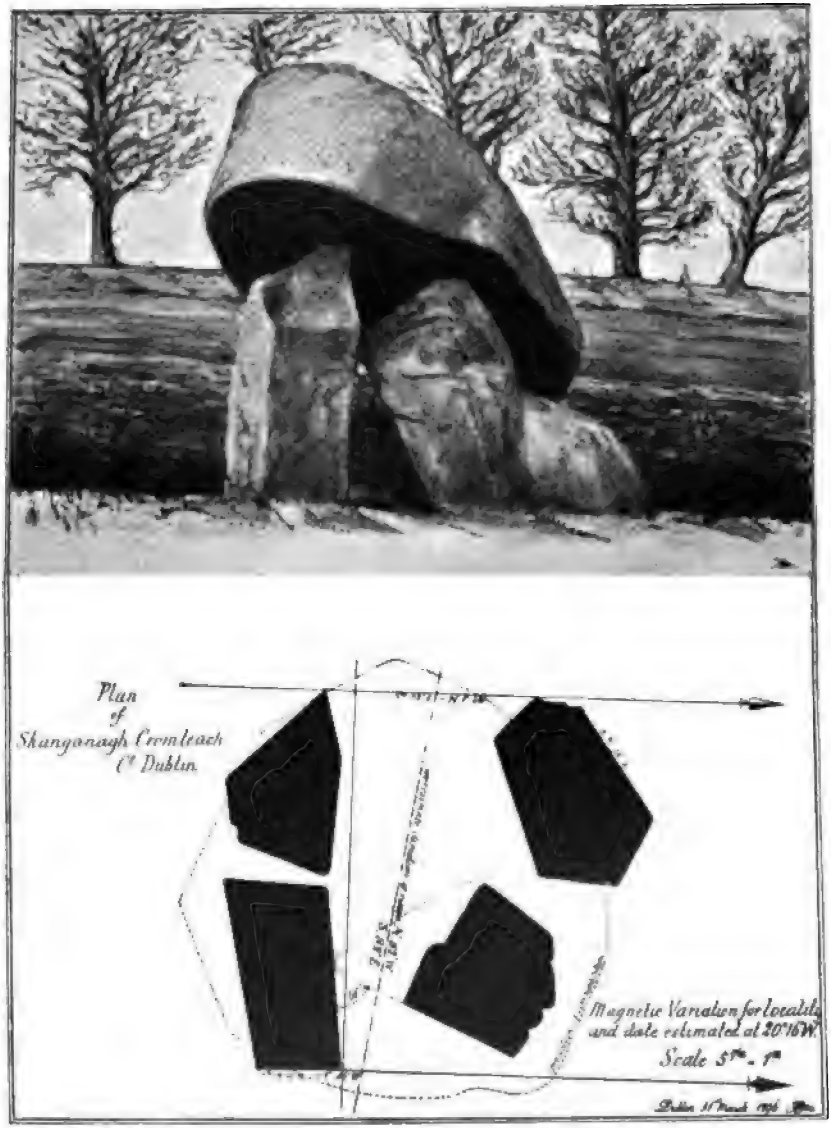
Let S' be the quadric surface which contains all the points in the second system corresponding to the points of S regarded as the first system. Then O' will lie on S', and the rest of the intersection of S and S' will be a twisted cubic C, which passes through the four double points.

Take any point P on C, and draw any plane through P. Then every ray of the first system of the pencil through P in this plane will have as its correspondent in the second system the ray in some other plane pencil L. One, at least, of the rays in the pencil L will cut the cubic C. Call this ray X', and draw its correspondent X in the first system passing through P.

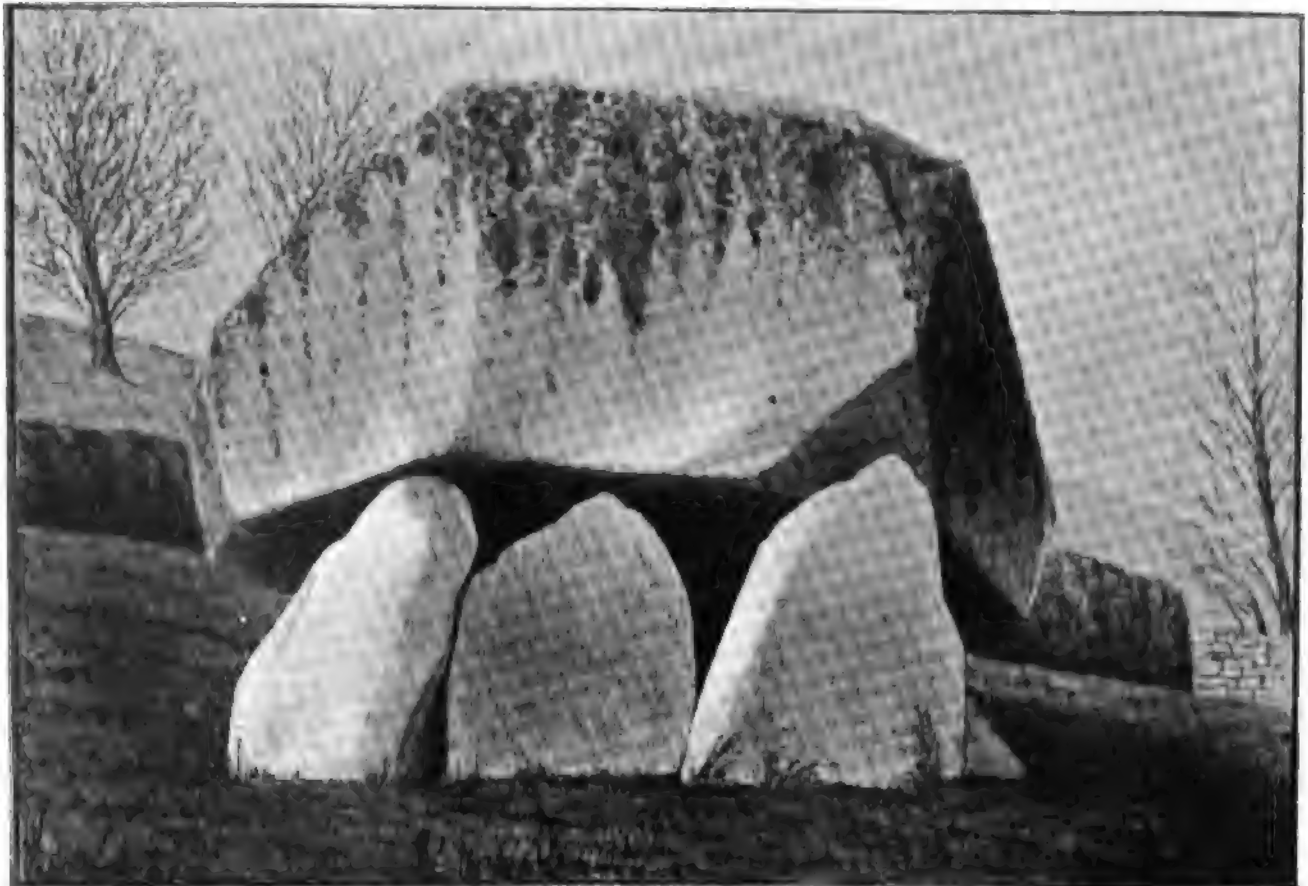
We thus have a pair of corresponding rays X and X', each of which intersects the twisted cubic C.

Draw pairs of corresponding planes through X and X'. The locus of their intersection will be a quadric S'', which also contains the four double points.

S'' and C, being of the second and the third order respectively, will intersect in six points. Two of these are on X and X', and are thus distinguished. The four remaining intersections will be the required double points, and thus the problem has been solved.



WM. STRAIN & SONS, BELFAST



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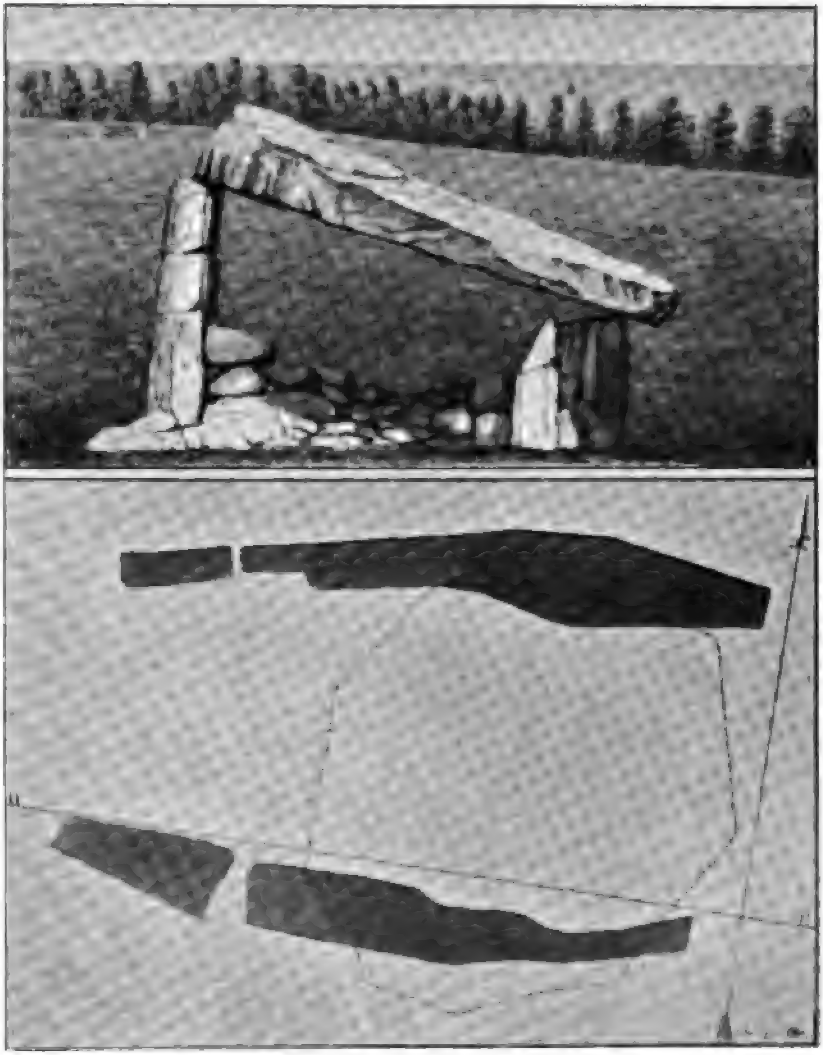

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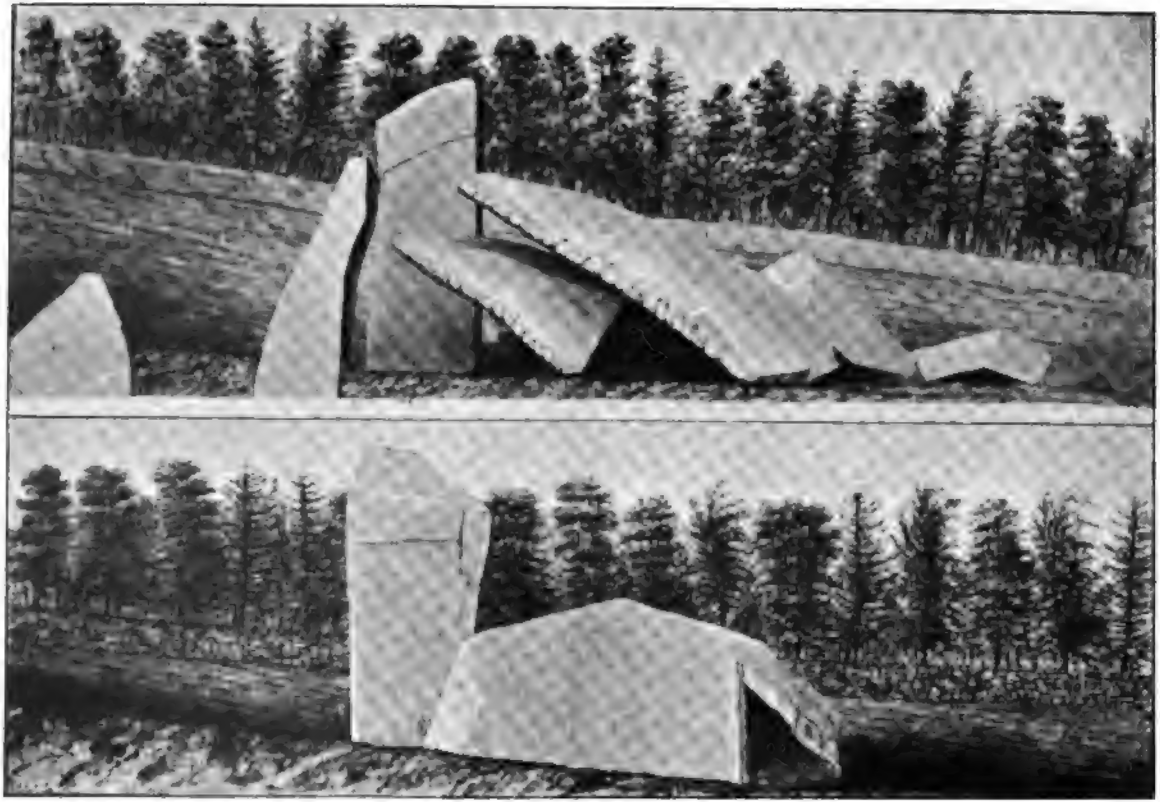

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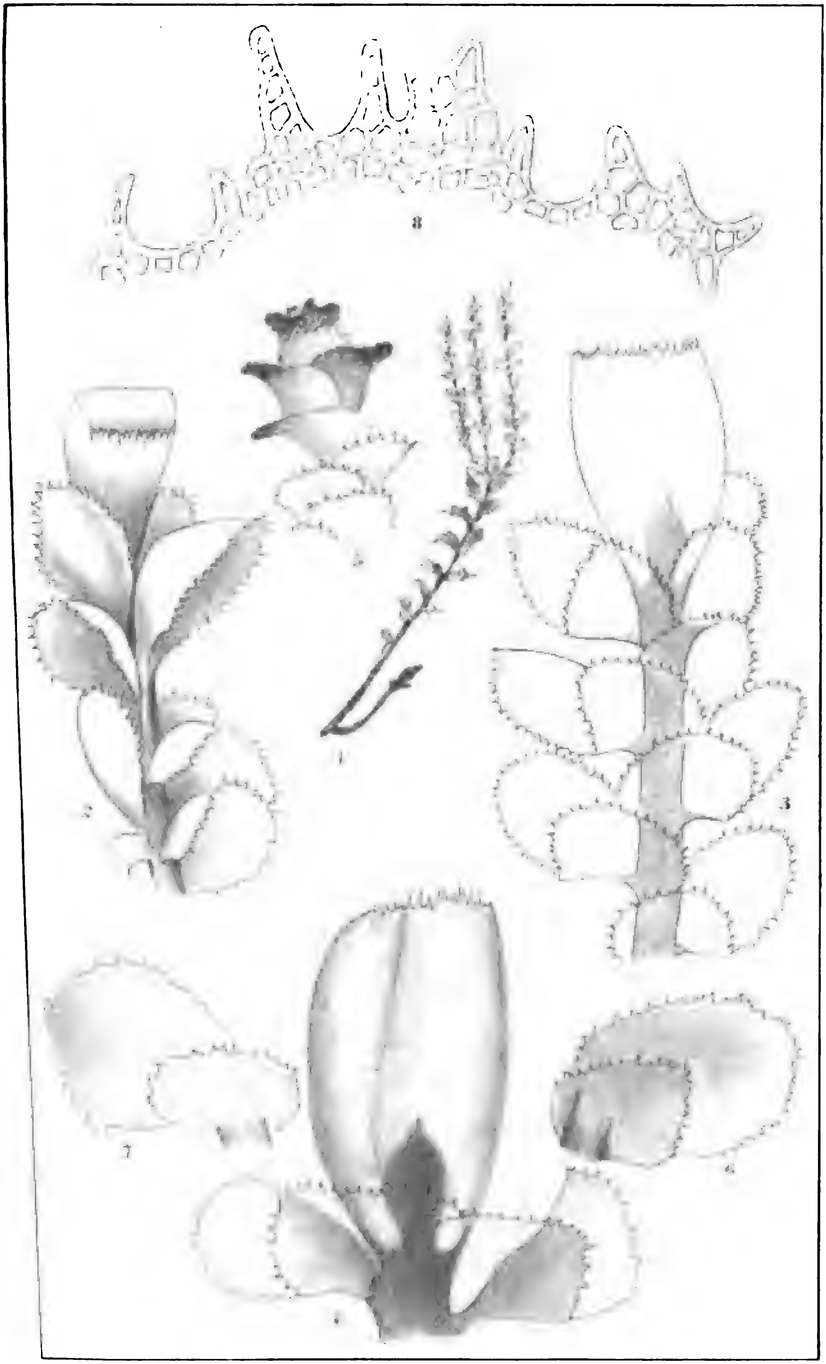
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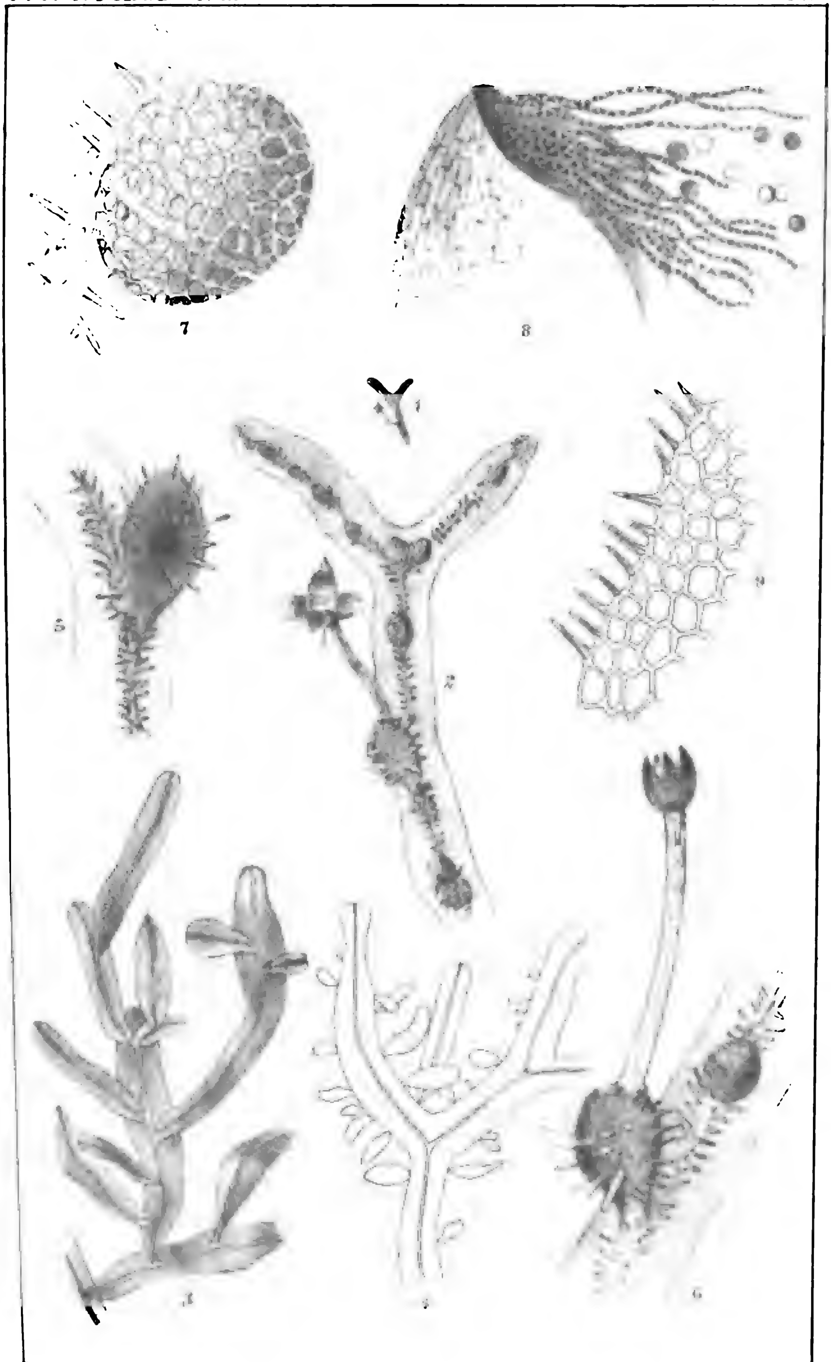


W H Allen ad nat. del. Nov 1891. Geo West & Sons Lith.

Royal Irish Academy.

GENERAL ABSTRACT OF THE ACCOUNTS

FROM

1st April, 1897, to 31st March, 1898.

ROYAL IRISH

GENERAL ABSTRACT OF THE ACCOUNT OF REV. MAXWELL

FOR THE YEAR END

RECEIPTS.		Total of each Class
	£ s. d.	£ s. d.
Balance from last Year,	16 17 0	16 17 0
PARLIAMENTARY GRANTS:—		
General grant in aid, ...	1500 0 0	
[For Treasure Trove Account see below.]		
Refund by Government, on account of Annals of Ulster,	43 12 0	1543 12 0
SCIENCE GRANT:—		
Returned by Grantees, ...	35 0 0	35 0 0
MEMBERS' PAYMENTS:—		
Entrance Fees, ...	36 15 0	
Annual Subscriptions, ...	274 1 0	310 16 0
PUBLICATIONS SOLD:—		
Transactions and Cunningham Memoirs, ...	7 3 3	
Proceedings, ...	2 1 3	
Irish Facsimiles, ...	18 8 0	
Todd Lectures, and Irish MSS. Series, ...	10 18 2	38 10 8
INTEREST ON INVESTMENTS:—		
Life Composition—2¾ per Cent. Consol. Stock, . . .	110 15 9	
Cunningham Bequest—2¾ per Cent. Consol. Stock, . .	70 10 8	
Geological Illustration Fund—2¾ per Cent. Consol. Stock,	11 11 4	192 17 9
		£2137 13 5

TREASURE TROV

	£ s. d.
Balance from last year, ...	9 18 11
Grant 1896–7, ...	100 0 0
	£109 18 11

TODD MEMORI

	£ s. d.
Balance from last year, ...	2 15 10
Interest on investments, ...	42 7 7
	£45 3 5

I certify that the above account is correct, according to the best of m

ADEMY.

CLOSE, TREASURER OF THE ROYAL IRISH ACADEMY,

OF MARCH, 1898.

PAYMENTS.	£	s.	d.	Total of each Class. £	s.	d.
For SCIENTIFIC AND LITERARY PURPOSES:—						
Scientific Reports,	235	0	0			
Library,	303	8	6			
Irish Scribes, &c., for Dictionary Work,	183	7	5			
Printing Preface and Index of Annals of Ulster,	43	12	0			
Printing Transactions and Proceedings and Cunningham Memoirs, and Memoir, in folio, on "Irish High Crosses,"	563	8	5	1328	16	4
„ **ESTABLISHMENT CHARGES:—**						
Salaries,	371	10	0			
Wages and Liveries,	217	4	6			
Furniture and Repairs,	9	5	11			
Fuel and Gas,	52	7	1			
Insurance and Law Expenses,	8	2	6			
Stationery,	13	12	3			
Printing (Miscellaneous),	16	2	0			
Postage,	21	9	5			
Freights, Incidentals, and Contingencies,	73	7	0	783	0	8
„ **INVESTMENTS (CAPITAL):—**						

	Stock Bought. £	s.	d.	Description.	Total Stock. £	s.	d.
Life Membership Compositions,	—	—	—	Gov. 2¾ Stock,	4181	17	11
Cunningham Fund,	—	—	—	Do. do.	2653	9	9
Geological Illustration Fund,	—	—	—	Do. do.	435	7	4
Todd Memorial Fund,	38	18	7	Do. do.	1641	16	1

	£	s.	d.	£	s.	d.
„ Balance to Credit,	25	16	5	25	16	5
				£2137	13	5

OUNT.

	£	s.	d.
Antiquities purchased,	109	18	11
	£109	18	11

OUNT.

	£	s.	d.
Purchase of £38. 18*s*. 7*d*. Government 2¾ per Cent. Stock,	43	8	5
Advertisements of Vacant Todd Professorship,	1	15	0
	£45	3	5

owledge and belief.—Maxwell H. Close, *Treasurer, R.I.A.*—

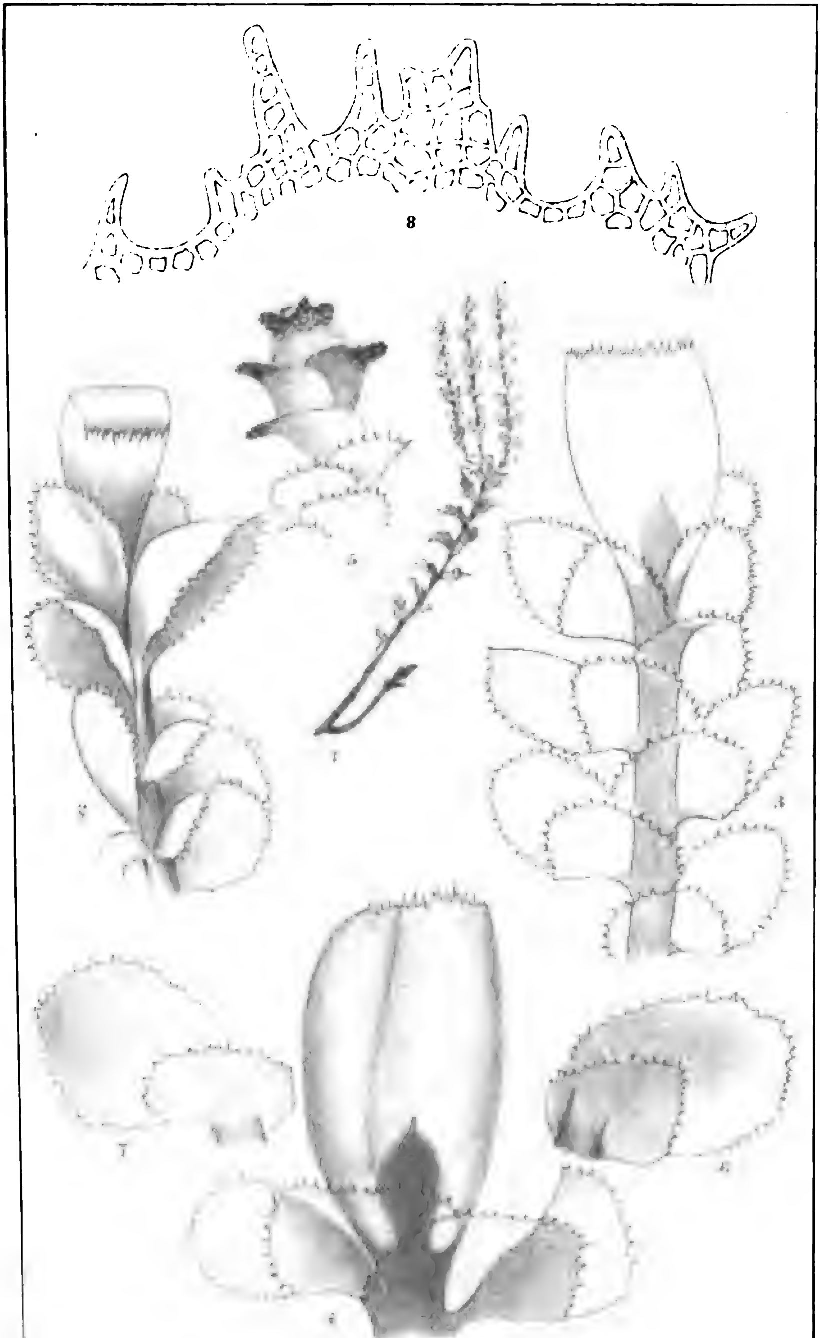
AUDITORS' REPORT.

We have examined the above General Abstract, and compared the Vouchers for the details of the several heads thereof, and find the same to be correct, leaving a Balance to the credit of the Academy's General Account of Twenty-five Pounds Sixteen Shillings and Five Pence.

The Treasurer has also exhibited to us Certificates in respect of the invested *Capital*, showing that the amounts of Stock standing in the name of the Academy were Two Thousand Six Hundred and Fifty-three Pounds Nine Shillings and Nine Pence, 2¾ per Cent. Consolidated Government Stock, Account A, being the Capital of the "Cunningham Fund"; Four Thousand One Hundred and Eighty-one Pounds Seventeen Shillings and Eleven Pence, 2¾ per Cent. Consolidated Government Stock, Account B, being Capital derived from Life Compositions; and Four Hundred and Thirty-five Pounds Seven Shillings and Four Pence, 2¾ per Cent. Consolidated Government Stock, Account C, being the Capital of the Geological Illustration Fund. Like Certificates have been exhibited to us showing a sum of One Thousand Two Hundred and Nine Pounds Eighteen Shillings and Four Pence, 2¾ per Cent. Consolidated Government Stock, in the Court of Chancery, and a sum of Four Hundred and Thirty-one Pounds Seventeen Shillings and Nine Pence, 2¾ per Cent. Consolidated Government Stock, standing in the names of Trustees, which together form the Invested Capital of the "Todd Memorial Fund."

(Signed), WILLIAM FRAZER, WILLIAM REYNELL, *Auditors.*

28th May, 1898.



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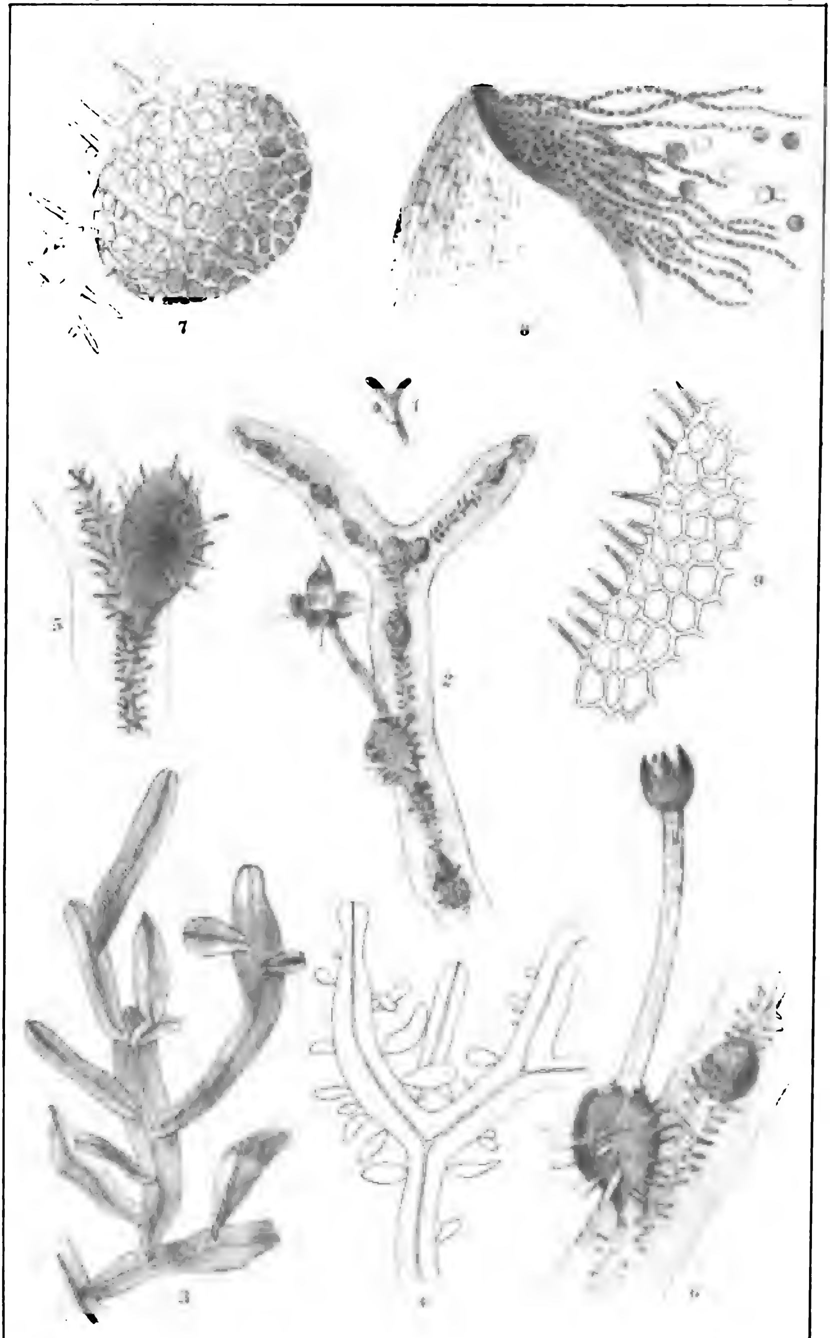

W H Allen ad nat del Nov 1891. Geo West & Sons lith.

Royal Irish Academy.

GENERAL ABSTRACT OF THE ACCOUNTS

FROM

1st April, 1897, to 31st March, 1898.

MONDAY, JUNE 10, 1895.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Patrick J. Barry, L.R.C.S.I.; Samuel W. Percy Cowan, M.A. (Dubl.); Lieut.-Colonel Thomas Ainslie Lunham, M.A. (Dubl.); and Rev. James Edward Harnett Murphy, M.A. (Dubl.), were elected Members of the Academy.

Professor Sollas, F.R.S., read a Paper on "A Tertiary Volcanic Neck near Bunown, Clifden, Co. Galway."

Rev. E. Hogan, S.J., read his Fourth Todd Memorial Lecture on certain Passages from the Leabhar Breac.

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, JUNE 24, 1895.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

The President announced the death, since the last meeting of the Academy, of Dr. Valentine Ball, C.B., F.R.S., a Vice-President of the Academy.

The following resolution was proposed by Sir John Banks, K.C.B., seconded by Master Pigot, M.A., and unanimously adopted:—

"That the Royal Irish Academy has received with deep regret the announcement by the President of the death of Dr. Valentine Ball, C.B., a Vice-President of the Academy, and desires to record its sense of the loss sustained by Science as well as by the Academy in his untimely death.

"The Academy hereby tenders to Mrs. V. Ball and her children its sincere sympathy and condolence with them in their bereavement."

The Secretary read for Mr. Ernest A. Smith, F.C.S., a Paper on "The Metallic Composition of some Ancient Irish Gold and Silver Ornaments." [Communicated by Professor J. P. O'Reilly, C.E.]

Mr. G. Coffey, B.A.I., exhibited Photographs and Rubbing of an Early Christian Gravestone recently found at Duleek, county Meath.

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, NOVEMBER 11, 1895.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Mr. S. W. Percy Cowan, M.A., signed the Roll, and was admitted a Member of the Academy.

Dr. W. Frazer read a Paper by himself and Mr. Edmond Johnson "On some Irish Gold Ornaments, illustrated by the exhibition of a considerable find of large Fibulæ in the South of Ireland, and a description of the Art Processes used in their manufacture."

Mr. George Coffey, A.I.B., read a final report on the Sepulchral Remains of the Lough Crew Hills.

By permission of the Academy, Mr. Henry Dixon, B.A., read a Paper on "The Nuclei in Lilium and Fritillaria."

Read the following recommendation from Council:—"The Council recommend the Academy to lend their Mace (properly insured) to the Arts and Crafts Exhibition."

On the motion of Master Pigot, seconded by Professor Johnson, it was resolved that this recommendation be referred back to the Council to take into consideration the desirability of having the Mace returned to the officers when required.

Read the following letter from Mrs. V. Ball:—

"28, WATERLOO ROAD,
"*July* 9, 1895.

"DEAR DR. WRIGHT,

"I have received the copy of the resolution passed by the Royal Irish Academy at the meeting on the 24th of June, relating to my late husband. Will you kindly express to the Academy how grateful I feel to them for this recognition of his services both to the Academy and to Science.

"It was, I know, a great gratification to him to have been named as a Vice-President, for he always took the greatest possible interest in the Academy and its proceedings. It was a great pleasure to him to serve on the Council and to attend the meetings, and his most intimate and valued friends were among the members of its body.

"I remain, yours truly,
"MARY BALL."

Read the following letter from Dr. Zeller:—

"STUTTGART, REINSBURGSTR. 56.

"29. *März* 1895.

"Die hohe Royal Irish Academy hat mir durch die Wahl zu Ihrem Ehrenmitglied, deren Urkunde mir gestern zugekom̄en ist, eine Auszeichnung erwiesen, für welche ich Derselben meinen tiefsten und verbindlichsten Dank ausspreche. Je weniger ich mich bei meinem vorgerückten Lebensalter der Hoffnung hingeben darf, der Wissenschaft noch weitere erhebliche Dienste leisten zu kön̄en, um so erfreulicher ist es mir, diejenigen, welche ich ihr bisher zu leisten versucht habe, von einer so angesehenen wissenschaftlichen Korporation so gütig und anerken̄end gewürdigt zu sehen. Es gereicht mir zur hohen Ehre, mich fortan dieser Körperschaft zuzählen zu dürfen, und ich bitte Sie, mit meinem lebhaftesten Danke für Ihre Güte zugleich der ausgezeichneten Hochschaetzung Ausdruck geben zu dürfen, mit welcher ich bin

"Einer hohen Academie,

"Verehrungsvoll ergebener,

"DR. E. ZELLER."

The following was agreed to as an Address of welcome to His Excellency the Lord Lieutenant:—

To His Excellency, GEORGE HENRY, EARL CADOGAN, K.G., Lord Lieutenant-General and General Governor of Ireland.

MAY IT PLEASE YOUR EXCELLENCY,

We, the President and Members of the Royal Irish Academy, desire to offer to your Excellency our respectful congratulations on your appointment to the high office of Viceroy by Her Most Gracious Majesty the Queen.

More than one hundred years ago the Royal Irish Academy, founded by His Majesty George III. through the influence of the then Earl of Charlemont, received its Royal Charter for promoting the study of Science, Polite Literature, and Antiquities.

The record of our labours in these great departments will, we trust, show how earnestly we have sought to promote the study of each.

In the various branches of Science, the Academy may claim to have fully performed her part in the past, and is still actively engaged in the work of original research.

If Literature did not present so large a field for our endeavours, we are still able to point to important work recently done in the subjects of ancient Greek Papyri and Manuscripts of the Early Fathers as a proof that this portion of our duty is not neglected.

In our Museum of Irish Antiquities, now in part displayed in the New Museum of Science and Art, will be found a collection of great value as illustrating the past history and early civilization of this country.

By the publication of a series of Facsimiles of the old Irish Texts in our Library, we have placed the unique Manuscripts we possess within the reach of all scholars. In this latter expensive work we gratefully acknowledge the assistance given to us by Trinity College, Dublin. We have also superintended for Her Majesty's Treasury the publication of some of the ancient Annals of Ireland, and have taken a part in the investigation of the Ethnography of the people of our Western Isles.

Your Excellency by virtue of your office is Visitor of the Academy. We hope to have the opportunity of showing you our Collection of the Antiquities of Ireland—stone, iron, bronze, silver and gold, and we would further hope that you may be graciously pleased to visit our Library to inspect some of our old Irish Manuscripts and Books.

Signed on behalf of the Royal Irish Academy,

J. K. Ingram, *President.*
E. P. Wright, *Secretary.*

Royal Irish Academy House,
Dawson-street, Dublin.

It was resolved that the marked thanks of the Academy be given to W. G. D. Goff, Esq., of Glenville, Waterford, for his liberal offer to deposit for the present, in the Academy's Museum, the collection of Irish Gold Ornaments, now exhibited, on the condition that his name shall be attached to the deposit.

Donations to the Library were announced, and thanks were voted to the Donors.

SATURDAY, NOVEMBER 30, 1895.

(STATED MEETING.)

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Mr. John Vinycomb and Mr. Francis J. Bigger signed the Roll, and were admitted Members of the Academy.

A ballot was opened for the election of a Member of Council. Deputy Surgeon-General King and Dr. Joyce were appointed Scrutineers.

Mr. Francis J. Bigger read a Paper on "Prehistoric Settlements at Portnafeadog, in the parish of Moyrus, Connemara."

Mr. F. J. Bigger also exhibited some photographs of early Christian antiquities at Inishmacdarragh, off Roundstone, not apparently hitherto exhibited.

Donations to the Library were announced, and thanks voted to the Donors.

On the report of the Scrutineers the President declared the Earl of Rosse, K.P., F.R.S., elected a member of Council on the Committee of Science.

The President, under his hand and seal, nominated the Earl of Rosse a Vice-President of the Academy.

The following recommendation from Council was adopted:—

"The Council recommend the Academy to lend their Mace (properly insured) to the Arts and Crafts Exhibition, subject to having it returned to the Academy at such times as it shall be demanded by the Treasurer."

MONDAY, DECEMBER 9, 1895.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Francis Elrington Ball and Rev. William Spotswood Green, M.A., were elected Members of the Academy.

Mr. Charles J. Joly, M.A., F.T.C.D., read a Paper on "The System of Scalar Invariants of two Linear Vector Functions."

By permission of the Academy, Mr. A. Vaughan Jennings, F.L.S., read a Paper on "Two new species of Phycopeltis from New Zealand."

Part 17 of *Transactions*, vol. XXX., "On the Cytology of the

Vegetative and Reproductive Organs of the Saprolegnieæ," by Marcus Hartog, M.A., D.SC., Professor of Natural History, Queen's College, Cork, was laid on the table.

The President mentioned that he had, in company with many of the Members of the Academy, presented to His Excellency the Lord Lieutenant the Address voted by the Academy, and that His Excellency was pleased to give the following reply:—

MR. PRESIDENT AND GENTLEMEN,

I thank you very heartily for your congratulations on my appointment to the high office of representative of her Most Gracious Majesty the Queen in Ireland. The record of the labours of the Royal Irish Academy in the various branches of science, polite literature, and archæology to which you allude is known and appreciated, and the conspicuous success which the Royal Irish Academy has achieved merits recognition. Your researches in the subjects of ancient Greek papyri and manuscripts of the Early Fathers have been most beneficial, and your publication of *fac-similes* of old Irish texts and manuscripts has brought them within the reach of scholars, and has fostered and developed our knowledge of the early literature and annals of Ireland. I am proud of the office of Visitor of the Academy, which I hold by virtue of my position as Viceroy of Ireland, and I am gratified by the expression of your wish that I should visit your collection of Irish antiquities and your valuable library of old Irish manuscripts and books.

It was moved by Master Pigot, seconded by Judge Kane, and resolved:—

"That the attention of the Council be called to the importance of having the notice relating to Treasure Trove forwarded to the various Constabulary Barracks and National Schools in Ireland, as formerly."

MONDAY, JANUARY 13, 1896.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Mr. Francis Elrington Ball signed the Roll, and was admitted a Member of the Academy.

Rev. Hugh O'Reilly was elected a Member of the Academy.

By permission of the Academy, Mr. E. E. Fournier d'Albe, B.SC., read a Paper on "The Identity of Energy." [Communicated by Prof. J. P. O'Reilly, C.E.]

By permission of the Academy, Mr. H. Dixon, B.A., read a Paper on "Rôle of Osmosis in Transpiration in Plants." [Communicated by Prof. E. P. Wright, M.D.]

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, JANUARY 27, 1896.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Mr. R. Lloyd Praeger, B.E., read a "Report on the Raised Beaches of the North-East of Ireland."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, FEBRUARY 10, 1896.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Rev. William Spotswood Green, M.A., signed the Roll, and was admitted a Member of the Academy.

Mr. Caesar Litton Falkiner, M.A., and Lieut.-Colonel George T. Plunkett, Royal Engineers, retired, were elected Members of the Academy.

Rev. T. Olden, M.A., read a Paper on "The Paten of Gourdon, illustrated from the Book of Armagh."

Dr. W. Frazer read a Paper on "Chambered Tumuli, and their Construction," and also exhibited some remains of a wooden house recently discovered by Mr. Thomas Drew, R.H.A., at St. Michael's Hill, Dublin, on the site of the old hazel forest and bog.

The President received from the Subscribers, on behalf of the Academy, an Oil Portrait (by Miss Purser) of the late Sir Robert Kane, LL.D., F.R.S., President of the Academy (1877–82).

MONDAY, FEBRUARY 24, 1896.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

His Excellency the Lord Lieutenant, Earl Cadogan, K.G., Visitor of the Academy, having arrived,

The President delivered the following Address:—

IT was formerly the practice of the Council of the Academy to award, from time to time, medals on the Cunningham foundation to the authors of papers in our "Transactions," and occasionally even of independent publications, which were considered to possess eminent merit. An arrangement was afterwards made by which the available fund is usually devoted to the printing and the often costly illustration of certain selected papers, of such excellence that, under the previous system, medals would fitly have been awarded to them. These are published as "Cunningham Memoirs." This change in our mode of honouring some of our most valued contributors does not, I am advised, discharge me of the duty which the President performed in bestowing the medals—that, namely, of explaining in a general way the objects of the several memoirs, the mode of treatment followed in them, and the principal results arrived at. I am not at all disposed to evade this obligation; far otherwise: it is a pride and pleasure to me to dwell thus on some of the best intellectual products of the Academy. Accordingly I now proceed[1] to speak of three of what may be called our Mémoires Couronnés, which have been either read, or distributed to our members, during the period of my Presidency.

I.

The first of these is the Memoir by Professor Cunningham, entitled, "Contributions to the Surface Anatomy of the Cerebral Hemispheres."

Though the study of the brain—rather, however, from the physiological (or functional) than the anatomical side—has always had a special fascination for me, I am, of course, incompetent to

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[1] Part of the following Address had to be omitted in the delivery, in consequence of the limitation of time.

pronounce an independent judgment on any disputed point respecting it. If I venture to indicate the range of Dr. Cunningham's researches and some of the most important conclusions at which he has arrived, it is because the excellence of his method and the luminous nature of his exposition have made it possible for me to follow him, where with a less able guide I should have failed to make my way.

As Dr. Cunningham says at the outset, "the descriptive anatomy of the adult human cerebrum is now very nearly complete," and "what still remains to be done is the establishment of our knowledge on a proper morphological basis." Now the higher research to which he thus points embraces two studies—first, that of the development of the surface of the human cerebrum from the early embryonic stages up to mature life; and, secondly, the comparison of the human cerebrum both in its constituent parts and in their gradual modifications with the simian cerebrum, especially in the anthropoids; in other words, the study of evolution and of anatomical comparison—or, as they are now sometimes called, ontogenetic and phylogenetic research. Neither of these studies, of course, is new; but to both, Dr. Cunningham has made large contributions. Taking some of the most important cerebral fissures, first those which are temporary, and afterwards, in succession, the Sylvian, the Rolandic, the intraparietal, and those of the frontal lobes, he examines the history of their formation, and, as illustrated thereby, the growth of particular areas of cortex; and then the change of position on the surface which those fissures, or some of them, undergo after they have been once laid down.

The special features of his mode of investigation are these:—1, the brain is hardened *in situ*, instead of being first removed from the cranial cavity; and 2, the measurements he makes on the surface are not absolute, but relative to the mesial length of the hemisphere, and he is thus enabled to fix corresponding points in brains of different sizes and at different stages of growth.

In man, except in abnormal cases, the complete fissures on the outer faces of the hemisphere have, in general, only a temporary existence during an early period of development; as the cerebral growth proceeds, they are obliterated, and leave the surface again smooth. Some of the complete fissures on the mesial face of the hemispheres are retained, in whole or part, in the adult cerebrum; there is much interesting matter in the Memoir relating to these, on which, however,

I cannot dwell. The transitory fissures result from deep infoldings of the thin cerebral wall. The influence at work in their production appears to be purely mechanical—a restraint placed on the longitudinal growth of the hemispheres. Most anatomists have regarded the occipital lobe as a secondary formation—a local out-growth from the hinder part of the hemisphere, the early condition of the brain presenting only the frontal, temporal, and parietal lobes. From this view Dr. Cunningham dissents. He holds the occipital lobe to be an original formation which arises from the general growth of the brain, and whose shape is determined by the restricted space it has to occupy above the cerebellum. Now, the appearance and the obliteration of the transitory fissures seem to be closely related to the mapping-out of the occipital lobe. Those fissures are due to a difference between the rate of growth of the hemisphere wall and the skull capsule containing it. The development is initiated in the brain, and the changes involved in it are resisted by the enclosing cranium. When the primate brain is in the quadruped stage, there is an effort towards the formation of a distinct occipital lobe; but there is a pause in the growth of the cranium, and hence a temporary pressure which gives rise to infoldings of the cerebral wall. (It would seem to follow that, as Benedikt of Vienna has asserted, not only in the primates, but in the mammalia generally, there is an occipital lobe; this, however, cannot yet be stated with certainty.) As the lobe is formed, the foldings disappear, part of the agency in their obliteration being, however, most probably, in addition to the extension of the surface, the absorption of the folds. The transitory fissures have, with two exceptions, disappeared when the corpus callosum is fully formed, and its development may possibly have something to do with their disappearance.

Dr. Cunningham next proceeds to the study of the fissure of Sylvius, that important sulcus which separates the frontal and parietal lobes above from the temporo-sphenoidal lobe below, and which, with the exception of the great longitudinal, is the most conspicuous sulcus in the brain. It is sometimes, but wrongly, described as a complete fissure; the projection into the cavity of the hemisphere corresponding to it, is not the result of a folding in of the mantle wall, but is an elevation of the floor of the prosencephalon. The three limbs usually recognised as composing the fissure, namely, the anterior ascending, the anterior horizon-

tal, and the posterior horizontal, are formed by the meeting of the contiguous lips of the four opercula—the temporal, the fronto-parietal, the frontal, and the orbital. Sometimes the two anterior limbs are fused into one by the absence of a frontal operculum; sometimes they have a common stem and assume a Y-shape; this occurs when the apex of the frontal operculum or pars triangularis does not meet the temporal operculum. In consequence of a growth-antagonism between the fronto-parietal and temporal opercula, the posterior limb of the Sylvian fissure descends on the outer surface of the hemisphere up to the ninth year of life. Under the opercula lies the island of Reil. There is a close correspondence, which is plainest in the fœtal cerebrum, between the furrows and the convolutions on the insula and those on the outer surface of the hemisphere. It has three radial furrows similar in position to, and contemporaneous in origin, respectively, with three fissures of which I shall presently speak, namely, the Rolandic, the inferior præcentral sulcus, and the vertical portion of the intra-parietal sulcus. It is a curious fact that in the development of the sulci and gyri, the right insula is usually in advance of the left. Before birth the anterior end of the island is very nearly fixed in relation to the anterior end of the cerebrum, while the posterior end moves rapidly towards the occipital pole. After birth the posterior end remains fixed, while there is an oscillation in the position of the anterior end, which at first approaches, and afterwards moves back from, the anterior end of the cerebrum.

Very interesting are the results arrived at by a comparison of the fissures in the two sexes, and in the human and primate brain. Rüdinger asserted that all the convolutions of the cerebrum in the female fœtus are backward in their growth as compared with those in the brain of the male fœtus. Dr. Cunningham has not been able to satisfy himself of this; but, so far as relates to the insula, he recognises it as true. In male adults, the antero-posterior length of the island is relatively greater than in the female. The gyri and sulci on its surface are very poorly developed in the anthropoids, the orang being nearest to man in this respect. There is no frontal or orbital operculum in those apes. This constitutes one of the most striking differences which exist between the convolutionary arrangement of the ape and that of man. The submerged portion of the insula in the ape corresponds in reality with little more than the posterior two-thirds of the insula in

man. The anterior part of the insula in the ape is on the surface exposed to view and uncovered by opercula. When we compare the insula in man with the submerged portion in the apes, the latter is found to be much smaller in proportion. In the lower apes, the insula is very narrow, while the longer axis is greater relatively than in the anthropoids. In the human female, as well as in the anthropoids, the point at which the trunk of the Sylvian fissure appears on the outer surface of the hemisphere is slightly further back than in the male, and this is a retention of the infantile character. The left hemisphere has an average length slightly greater than that of the right. But the Sylvian fissure is considerably longer in the left hemisphere; and this is true of all periods of growth, and attains its full accentuation in the adult brain. There is apparently no appreciable difference in the length of the fissure in the two sexes, though the contrary has been asserted; in the ape the fissure is relatively longer than in man. What is called the Sylvian angle is wider, both in the apes and in man, on the left side than on the right; and this constitutes at every stage of growth a marked difference between the hemispheres.

Dr. Cunningham next passes to the fissure of Rolando, which, if it were named after him who first described it, ought rather to be called the fissure of Vicq-d'Azyr. It would best be called the "central" fissure, if that epithet be interpreted as indicating its approximate equidistance from the frontal and occipital poles of the hemisphere. One of the most remarkable points brought out by Dr. Cunningham in relation to the Rolandic fissure in man is the stability of its position on the surface at all stages of growth. It is usually formed in two portions, a lower and an upper, which appear independently, and afterwards unite.[1] In the lower apes a continuous, not an interrupted form of development seems to obtain.

[1] Since this Address was written, Dr. Cunningham has sent me the following interesting note in relation to what I have said on the formation of this fissure:—"The development of the fissure in two parts is very significant. The development of a fissure is brought about by an intensity of growth of the surface on either side of it; the surface grows up in the form of two bounding banks. This intensity of surface-growth is, of course, associated with the development of function in the area affected. The district immediately in front of, and behind the fissure of Rolando, is occupied by the motor centres of the lower limbs, upper limbs, and face in that order from above downwards. The appearance of the fissure in two parts probably means the separate appearance of the arm and leg

Dr. Cunningham dissents from several of his predecessors as to a sexual difference in the position of the fissure of Rolando, which they regarded as indicating a greater relative mass of brain-matter in the frontal lobe in the male than in the female. This difference Dr. Cunningham has not observed; if there be any, he thinks it is in favour of the female frontal lobe. In the Rolandic angle, too, in which the apes differ from man, some writers find a sexual human difference, which Dr. Cunningham, as well as Eberstaller, denies. The only variation he recognises is that in brachycephalic heads the angle opens out, and in dolicocephalic heads becomes more acute. The length of the Rolandic fissure is substantially the same in the two sexes, but is much greater in the anthropoids than in man. Curiously, in the chimpanzee and orang the upper end of the Rolandic fissure is further back than in man, which indicates a greater relative antero-posterior length of the upper part of the frontal lobe in the anthropoids; but the lower part is much shorter than in man. In the lower apes of the old world the fissure of Rolando is, throughout its course further forward than in the human hemisphere.

Coming now to the intraparietal furrow of Turner, Dr. Cunningham observes that it is rather a system of sulci than a single sulcus. It consists of three portions: the sulcus postcentralis, divided into a superior and an inferior portion; the ramus horizontalis, and the ramus occipitalis. As to the process of its evolution and the typical arrangement of its parts, there has been considerable difference of opinion among anatomists. From a study of the brain in the fœtal condition and in the apes, Dr. Cunningham arrives at the conclusion that the ramus horizontalis and the inferior sulcus postcentralis are originally continuous, whilst the superior sulcus is a superadded element. In the human brain is found every possible form of combination of the segments of the sulcus distinct from the ramus occipitalis; but there is a general tendency towards a union of the two originally separate postcentral elements of the sulcus, and a divorce from the lower of these of the ramus horizontalis. The intraparietal

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centres. The lower part associated with the arm centres appears first, because the upper limbs in their development are always in advance of the lower limbs. In the embryo the buds which constitute the earliest form of the upper limbs have been pushed out before the corresponding hinder limb buds have made their appearance."

sulcus appears later than the fissure of Rolando on the human fœtal cerebrum, but curiously the opposite is the case in the simian brain, indicating that of the two fissures the intraparietal possesses the greater phylogenetic antiquity. Dr. Cunningham thinks that, by studying the arrangement of its different parts in different ethnic brains, we may be able to point to racial distinctions indicated by the varieties. There is another segment of the intraparietal sulcus which Ecker described under the title of sulcus occipitalis tranversus. This is not, as has been supposed, the homologue of the Affenspalte in the apes, which, as Dr. Cunningham elsewhere shows, is really homologous with the transitory external perpendicular fissure in man.

In proceeding to study, lastly, the sulci on the external surface of the frontal lobe, we are struck by a remarkable analogy between the præcentral and the intraparietal sulci. The præcentral sulcus has two portions corresponding to those of the postcentral; the former, however, unlike the latter, generally remain separate from each other. There are also, in the frontal lobe, furrows which correspond respectively to the ramus horizontalis and the ramus occipitalis of the parietal lobe, and a terminal bifurcation of the second of these frontal furrows, corresponding to the sulcus occipitalis transversus. But, according to Dr Cunningham, the morphological relations of these rami in the parietal lobe are quite different from those of the furrows in the frontal lobe which resemble them in form and position. The parietal rami are simultaneously developed, and in the lower primates they are continuous, whilst the two corresponding frontal sulci appear, in general, at different times, and one of them is entirely absent in the lower apes. His view is thus altogether different from that of Eberstaller, from whom he also dissents as to the parallelism of the relation between the first frontal furrow and the sulcus præcentralis superior with that between the second frontal furrow and the sulcus præcentralis inferior, which two latter sulci he regards as morphologically distinct fissural elements, whilst the former two are closely connected, if not to be completely identified.

On no part of the cerebral surface are the character and mode of development of the sulci so variable as on the frontal lobe. These varieties Dr. Cunningham studies with minute care, and estimates numerically the frequency of the different forms in the brains he has

examined. Into those elaborate details I do not enter; but the general conclusion at which he arrives is of great importance—it is that the several sulci appear, on the average, in the following order—first, the sulcus præcentralis inferior and the second frontal furrow; then the lower portion of the sulcus præcentralis superior, with the basal part of the first frontal furrow; and afterwards, in succession, the anterior part of this last with the upper part of the sulcus præcentralis superior; next the sulcus frontalis medius; and lastly the sulcus frontalis mesialis. It would be natural to suppose that this order represents the relative degrees in which those sulci are stamped on the structure of the primate brain generally; but, in order to ascertain this, the question of the homologues of these several furrows in the simian cerebrum must first be determined. Dr. Cunningham goes into a most careful study of the sulci in the ape cerebrum from Cebus up to the anthropoids, and, differing from some of his most eminent predecessors, he arrives at the following conclusions.

The sulcus frontalis inferior in man, he holds (with Gratiolet), corresponds in the apes with what Mingazzini has called the sulcus rectus, which already appears in Cebus. The sulcus præcentralis inferior corresponds to the sulcus arcuatus which is well seen in Callithrix. The sulcus frontalis primus is of comparatively late origin, and is absent in some of the lower apes; when it appears, it is represented by certain shallow furrows which lie between the horizontal part of the sulcus arcuatus and the mesial border of the hemisphere. The hindermost of these, Dr. Cunningham thinks (so far agreeing with Eberstaller), may be a sulcus præcentralis superior. Lastly, the sulcus frontalis mesialis, which, in man, divides the superior frontal convolution into two, does not appear in the simian cerebrum at all, and is less strongly marked in the lower than in the higher human races. Thus the ontogenetic and phylogenetic evidences agree in fixing the order of importance of these frontal furrows.

Another alleged homology is discussed by Dr. Cunningham. The sulcus fronto-orbitalis has been regarded as representing in the anthropoids the anterior limb of the fissure of Sylvius. This he shows to be an error, arising from neglect of the fact, already mentioned, that there is no frontal and no orbital operculum in the anthropoids, a portion of the insula in them being exposed on the surface which in man is submerged. There is no anterior Sylvian limb in the

anthropoids; the fronto-orbital sulcus is really homologous to the anterior limiting sulcus of the insula in the human brain.

This closes my imperfect summary of Dr. Cunningham's investigations. The Memoir appears to me to show everywhere the hand of a master. It exhibits, in addition to patient and laborious research, and extraordinary learning in the history of cerebral study, such originality, penetration, and breadth of view as, in my opinion, stamp it as one of the most important scientific Papers ever contributed to our Transactions.

There is added to Dr. Cunningham's Memoir a chapter by Mr. Victor Horsley. Its object is to determine, as accurately as possible, the local relations of the chief fissures and gyri in the brain to different portions of the enveloping cranium, regard being had to variations arising from the size of the head, from age, sex, and pressure distortion. The author insists on the importance of using Dr. Cunningham's mode of preparing the cerebrum for study, and on the necessity of the measurements taken being not absolute, but relative to a general index. He proceeds to examine from his point of view the topography of the cerebrum as a whole, that of the fissures which separate lobes, that of those which sub-divide lobes, and, finally, that of the island of Reil. Throughout he recognises the great advance in our knowledge of the brain due to the labours of Dr. Cunningham, from none of whose conclusions do I find him dissenting. It would be impossible for me in the present address—even if I were competent for the task, to give an abridged view of the great body of details into which he necessarily enters. I will only say that I have been much impressed by the evidences to be found in his contribution to the Memoir, of the great ability, the extensive learning, and the thorough command of his subject, which, from his high reputation, it would be natural to expect.

II.

The next Memoir of which I have to speak is that of Dr. Mahaffy on the Flinders Petrie Papyri. In passing from Cerebral Anatomy to the Literæ Humaniores, I feel myself to some extent on firmer ground. But, though I was led in past years, as Librarian of Trinity College, to pay attention to some branches of Palæography, I

am not at all a specialist in that subject, particularly as regards writings on Papyrus; and in giving an account of Dr. Mahaffy's labours, I can only bring to bear the general knowledge and habit of mind which may be expected in an ex-Professor of Greek, and which may be regarded as qualifying him for judging of the results of work which he does not wish to imply that he could himself have performed.

Let me briefly recall to you the circumstances in which the investigation was undertaken. Mr. Flinders Petrie, well known as an Egyptologist and explorer, discovered in the desert not far from Gurob in the Fayyûm, a cemetery partly of the Ptolemaic period. Many of the mummy-cases in the tombs of this cemetery were made of layers of papyrus, which had been cut or torn into small pieces and glued together so as to form a thick carton. Mr. Petrie saw that the pieces of papyrus were fragments of discarded documents, most of them in Greek. To separate and cleanse them was a difficult, often an impossible, task. Many were stained or worm-eaten so as to be illegible, and a layer of chalk or lime laid over the papyri as a ground for colouring had, in most cases, destroyed the ink. Mr. Petrie brought home a large number of texts which he placed, in 1890, in the hands of Dr. Mahaffy and Mr. Sayce for examination and decipherment, if this should be found possible. Those scholars, working under great difficulties, separated and sorted many of the fragments, and laboured, not without success, on their interpretation. These form the subject of the first part of the Memoir. Afterwards, on his departure to Egypt in November of the same year, Mr. Petrie left with Dr. Mahaffy a store of unseparated fragments, which are printed and discussed in the second part of the Memoir, dated 1893. In dealing with the documents, Dr. Mahaffy liberally acknowledges such help as he received from his colleagues in Trinity College; but these gentlemen would be the first to recognise that the work was essentially his own.

Let me notice the several elements which composed this remarkable find. When such a discovery is made, we of course ask, first, whether it offers to us any literary compositions preserved in whole or part; and the recovery in recent years of several orations of Hypereides, of the Aristotelian Πολιτεία τῶν Ἀθηναίων, and of the poems of Herondas has awakened keen anticipation of similar successes to follow. It soon appeared that among the Gurob papyri there were several containing matter of this kind. There was, in the first place,

a considerable portion of the *Antiope* of Euripides—a play of which we had previously only some lines preserved through ancient quotations. There were long passages from the *Phædo* and the *Laches* of Plato. There was also an imperfect fragment which was recognised as coming from the XIth Book of the *Iliad*, differing in several particulars from the received text: a few verses, probably from Hesiod, and some very brief extracts from Epicharmus and Euripides, bearing the names of those writers. There were, besides, one or two partially defaced dramatic and elegiac pieces, a prose discourse on good fellowship, and other scraps—one apparently describing the funeral customs of different nations—all these by unknown authors.

It is, perhaps, natural to estimate at first too highly ancient fragments thus saved from the wreck of so much of the literature of the Greeks. But it must be the impulse of anyone possessed with the true spirit of a scholar, when such relics come into his hands, without too nicely considering their value, to try to ascertain their meaning and trace their origin. This Dr. Mahaffy has done with conscientious diligence, and has effected much towards their correct editing and their elucidation, though, from the mutilated state of many of the fragments, not all that he desired.

These classical remains do not, in my opinion, with one exception —that, namely, of the *Antiope*—contribute anything important to our knowledge of the ancient texts. We were aware that there were discrepancies in the early copies of Homer, as is shown, for example, by Aristotle's quotation in his *Politics* of the words πὰρ γὰρ ἐμοὶ θάνατος, which are not in our MSS. But I think there are internal indications that the passage from Homer in the papyri, which must have been a favourite one with physicians, is either incorrectly quoted from memory, or more probably is a transcription, in which the copyist has interpolated verses of his own. I certainly cannot regard it as affording evidence of a distinct textual tradition.[1] As to the passages of Plato, they are consolatory as showing us how little the text of the

[1] Observe ελοιεν and ελοιντο at the ends of consecutive lines, which would be impossible, and νοησεν in the line after 504, where it is plainly out of place. The corresponding line of the second column would also have ended with ενοησεν, and, therefore, if a copyist had the two columns before him, parablepsy would explain the error. If some scholar would reconstruct the passage according to the indications of the papyrus, we should see whether it could be made to wear a genuinely Homeric aspect in its new form.

third century B.C. differed from that of the more recent MSS. As Dr. Mahaffy remarks, only in one case do the papyri confirm the conjectural emendation (τοῦ for τῷ) of a modern critic; and the one different reading which strikes us as forcible, and which might conceivably have emanated from *curae secundae* of Plato himself, is ἀνδραποδώδη for εὐήθη in the *Phædo* as an epithet of the vulgar sort of courage.[1] But, apart from the interest of having before our eyes portions of Plato's works, transcribed probably within a hundred years of his death, these and the other classical fragments have, as we shall see, a real and great value when regarded from another point of view.

Before passing from the literary remains, I must not omit to specify one of them, the treatment of which required and elicited the exercise of Dr. Mahaffy's sagacity as well as his wide acquaintance with all that bears on the history of Greek literature. This was a passage which, at first sight, looked as if it was a portion of the well-known tract of the *Contest of Homer and Hesiod.* The tract mentions the Emperor Hadrian, and on this might have been founded an argument to show that some of the papyri were of much later origin than that which had been assigned to them. But Dr. Mahaffy was enabled, using researches of certain recent Continental critics, to show that the tract in question was only a *rifacimento*, but little altered, of a much older treatise, written, most probably, by Alkidamas in the fifth century B.C., and which is doubtless the source of the passage in the papyri.

Next after literary relics, we are prompted to inquire as to materials for elucidating the general history of the times of the early Ptolemies, to which, as we shall see, these documents are unquestionably to be referred. Such information would be welcome, for our regular sources for the period are more than commonly scanty; indeed, in dealing with its events, as Dr. Mahaffy says in his *Empire of the Ptolemies*, "we stumble about in darkness and uncertainty." Now, there is one document which gives some account of contemporary public transactions. It is almost certainly, as Dr. Mahaffy has seen, a letter written during the war waged by Ptolemy III. (Euergetes) against the Syrian King, Seleucus Kallinikos, to avenge the murder

[1] But it is improbable that the epithet ἀνδρ. should have been used in 68 E and introduced again in 69 B. I believe εὐήθη to be the right reading in the former place.

of his sister, just before the great expedition, if we should not rather, with Heeren, call it the great "foray," which was recorded on the marble of Adule. The letter is sent home by some one serving in the campaign, and describes the capture of a town in Cilicia, and the subsequent entry of the Egyptian troops, first into Seleukeia, on the Orontes, and afterwards into Antioch. There are in the letter some sentences which it is not easy to understand; two different cities—Seleukeia—seem to be mentioned without any distinctive addition to either name, and there is reference to an Epigenes, who, if he be the same who appears in Polybius as an officer of Seleucus Keraunos and of Antiochus the Great, ought to have been on the Syrian side, while he seems to have been on the Egyptian. But, on the whole, there can, I think, be no doubt that Dr. Mahaffy has quite correctly interpreted the passage, which accordingly, in his later historical volume, he has been able to use as contributing, in some small degree, to our knowledge of the reign of Euergetes.

Lastly, in Mr. Petrie's find, comes a very numerous body of more or less fragmentary documents relating to private or official business—wills, contracts, leases, receipts, taxing accounts, complaints addressed to the authorities, official correspondence, family letters, and the like. These papers have to do with the everyday affairs of the Macedonian and other members of a military colony which had been settled by Ptolemy Philadelphus in the Arsinoite nome on land probably reclaimed from Lake Moeris. We really know nothing, whatever may be conjectured, as to the exact circumstances and influences which led to the formation of this settlement. But, looking through Dr. Mahaffy's eyes, and studying with him these business documents, we do really gain a considerable insight into the life of the colonists, the transactions which went on among them, and their relations to the public authorities. It may be supposed to diminish the value of this information that it relates only to a peculiar and specially situated part of the population of Egypt; but I think that we may safely generalise, at least as to the conduct of the administration, from the methods pursued here to those followed in dealing with the whole Egyptian people. The ideas we gather from these papyri quite fall in with the impressions we obtain from the Revenue Laws of Philadelphus, since discovered, as to the bureaucratic government and fiscal system of the country at large.

There is a point affecting these Gurob documents which remains unexplained—When, and how, did they become available as waste paper for the purpose of the coffin-makers? Dr. Mahaffy has a theory to account for this; indeed, his ingenuity in devising explanations of every difficulty which arises is inexhaustible; and I confess that in reading, not this memoir only, but his other writings also, I find myself assuming a sceptical attitude by way of safeguard against the temptation to accept, as representing historical facts, his plausible hypotheses and subtle combinations. It is just, however, to add that he himself often regards them as merely tentative and provisional. Remarking, in his commentary on the papyri, that all these documents belong to the times of the Second and Third Ptolemies, he supposes that this was due to the disturbance which broke out in the later years of Ptolemy IV. He conjectures that the settlers lost their lands in the general confusion of the insurrection, which he represents as having been protracted and obstinate, and renewed again upon the accession of Epiphanes. I do not so understand Polybius; and Dr. Mahaffy, in his *Empire of the Ptolemies*, seems to have altered his view of the matter. The revolt was, according to Polybius, marked by mutual cruelty and treachery, but not by any pitched battle or siege or anything worthy of narration. It was a peasant revolt, as Dr. Mahaffy now sees, which never seriously shook the State, and could not have permanently dispossessed the military colonists. No mere revolt—nothing short of a successful revolution—could have had such an effect. The disturbances at the beginning of the reign of Epiphanes were a popular rising in Alexandria, not against the royal house, but in its vindication and defence against Agathocles and his sister. And, in fact, there are amongst the Petrie documents several of the reign of Epiphanes, so that the local legal registers continued to be maintained.

Now, if there is really no reason for believing in a "catastrophe" which dispossessed the military grantees, to what conclusion are we led? The wills, contracts, and other documents found here were no doubt cleared out of official shelves or lockers, possibly at one time; and, if they had been chronologically arranged, those of a single period would naturally enough be used by one set of coffin-makers. But is it conceivable that the copies of wills in a public registry office (to speak of no other documents) should have been treated as waste paper until a very long period had elapsed since they were recorded,

especially considering how sharply the bureaucracy looked after taxation, which is necessarily associated with property? And is it not possible that at that late date other materials, not of the same nature—for example, some literary papers—may have got mixed with business documents of the time of the Second and Third Ptolemies? I do not assert that this happened at Gurob; only that it is not a conclusive argument that, because classical texts are found mixed with the official papers, they cannot be younger than 220 B.C. The antiquity of any piece must, in the absence of a date, be judged by the character of the writing.

This brings me to what I consider the greatest value which attaches to Mr Petrie's discovery—I mean its bearing on Palæography. To see what an important contribution it has made to our knowledge in this branch of study, it is only necessary to look into the excellent little book on Greek and Latin Palæography recently published by the principal Librarian of the British Museum. We have, in this Gurob find, a large body of *dated* documents of the third century B.C. There are wills of the years 237, 235, and 224 B.C.; the oldest fragment—merely a scrap of text—belongs to 268 before our era. There are in the libraries of the world only a few Greek Papyri of equal antiquity, such as the Imprecation of Artemisia at Vienna; so that this find gives us almost the entire representation which we possess of the earliest stage of Greek writing other than sculptured inscriptions. It is, indeed, the study of the specimens handled by Dr. Mahaffy, that has led to the acknowledgment of the great, though not equal, antiquity of some papyri in the several European collections, which had been formerly assigned to later periods. We find in these Gurob remains, as elsewhere, two different kinds of writing. There is, first, the formal literary hand, ordinarily used by professional scribes in preparing books for the market, though sometimes employed for ordinary uses; and, secondly, the cursive hand, generally applied to every-day purposes, but occasionally used for literary ends by scholars or other persons not writing for the book trade. Of the former, the fragment of the *Phædo* of Plato is a beautiful example, and that of the *Antiope* one nearly, though not quite, as good; and the character of the letters used in them is believed, by the best judges, to prove their early Ptolemaic origin. Of the second kind of writing the business documents afford abundant specimens. Now, on a

general survey of these materials, one broad general conclusion forces itself upon us—namely this—the hand-writings, whether the literary or the less formal, show so much facility, boldness, and variety that plainly the practice of writing was quite common and habitual. Further, the styles are so confirmed—they bear, as has been said, so plainly on their face the stamp of matured development that they cannot differ much from those of the fifth century B.C.; so that, as Dr. Mahaffy says, Euripides and even Aeschylus wrote down their plays with the same ease of penmanship as Shakspeare. But we are thus carried still farther back, and the irresistible conclusion is that the ordinary use of writing, as distinguished from inscriptions on stone or metal, was very much older in Greece than has been commonly supposed.

I have only been able to touch some of the leading points in Dr. Mahaffy's Memoir; his careful and elaborate treatment of details must be directly studied in order to be duly appreciated. If any of my hearers has doubts as to the great difficulty of the task he undertook, I will respectfully invite him to try his powers on the excellent reproductions of the papyri by the Autotype Company. The Memoir is an admirable piece of work, well deserving of being crowned by the Academy. In saying so, I only add my less competent testimony to that of some of the best European Græcists and Egyptologists. An eminent worker in the same field has reminded us, "prima tentamina in re non bene perspecta optima esse, si mediocritatem attingant." In my judgment, Dr. Mahaffy has gone far beyond mediocrity: he has attained excellence. He has fully recognised the liberality of our Council which enabled him to publish promptly, and in fitting form and extent, the results of his labours. But, on our side, acknowledgments are due to him for having contributed to our Transactions a Memoir which possesses so much interest for scholars, and has so largely attracted the attention of the learned world.

III.

The third Memoir of which I have to speak is that of Professor Haddon on "The Decorative Art of British New Guinea." Savage art has only in recent times been the subject of systematic investigation; and many persons may be unaware that there is in existence

anything that deserves the name. But human nature is everywhere and at all times fundamentally the same; and even in very low stages of social progress the æsthetic craving shows itself. The savage is rarely satisfied with mere utility in the articles he uses; he aims at beauty according to his ideas of it. It is true that, in general, he does not represent objects in a purely disinterested way, nor does he idealise; his art is for the most part limited to the ornamentation of his arms and implements, and to some extent of the human person. The character of these early efforts will be conditioned by various circumstances. It will be dependent on the development of crafts, and the consequent multiplicity and variety, as well as the nature, of the tools at the artist's command, and also on the materials on which he operates; and when he uses colour, on his resources in pigments. Again, his art will be affected by religion, by the sacred figures, emblems, or instruments to be wrought or adorned. And the designs introduced will depend on the whole environment of the worker, on the character of the region in which he lives, and especially its fauna and flora. But it must not be assumed that everything which is familiar to the artist will be delineated. In some districts of New Guinea where animals abound they are scarcely ever represented; whilst in others a large number of forms are depicted. A ground for this diversity has been sought in the institutions of the several regions, particularly in the presence or absence of Totemism; but whilst these probably have some effect, there are doubtless deep-seated reasons in the psychological features of the different races which are too subtle to be traced. It is observed by Mr. Haddon that the abundance and richness of art is conditioned also by the material prosperity of the tribe. "A poor, miserable people has a poor, miserable art." A certain freedom from the cares of life is necessary for æsthetic culture. Where it flourishes in New Guinea, food is abundant, and men are well nourished; consequently vitality and energy abound. But even when material conditions are favourable, the spiritual faculty may be deficient. This is true of advanced races, and it is no less true of those which have lagged behind in the march of evolution.

In the study of the entire subject we are confronted by a special difficulty. It is often impossible from the vague indications in museums to ascertain accurately where a given object has been made; though the place where it was bought may be known, it may have

been produced elsewhere. There is, however, a circumstance which attenuates in some degree this difficulty—namely, the rigid conservatism of these retarded races, and the consequent fixity in the native art of each centre. "Patterns," as Mr. Haddon says, "have a wonderful vitality," and hence the locality may, in general, be safely inferred from the particular features of the work. This, however, is in turn liable to limitation; for certain simple patterns are found, not only in the different regions of New Guinea, but in various parts of the world, and the migrations of tribes may carry a form of art to a place which was not its native home. A case has even been found in which a kind of ornamentation previously unknown was introduced into one of the Torres Straits islands by a single native of a remote place who was shipwrecked on the coast. Such a fact shows that the conservatism of which I have spoken is not absolute; and the possibility of innovations is increased by the improved communication between districts which is now available, and by the contact of the natives with whites who visit their shores.

Examining the coast of British New Guinea, Mr. Haddon finds, in moving eastward along it, five successive districts, each of which appears to be characterised by a particular style of ornamental design. (There is a sixth district on the north-east side of the island, but scarcely anything is known respecting it.) Let me indicate these in the most general way. There is, first, the district facing Torres Straits, to which the islanders of the straits give the name of Daudai. Here the prevalent feature is straight and angled lines—the fundamental pattern being a zigzag between two parallel lines, which sometimes results in producing triangles or diamonds, and, by the rounding of the zigzags, semicircular forms. Animals are often represented, but always individually, not drawn in linear series, or grouped so as to tell a story. The forms, most commonly marine, are drawn with a fair amount of accuracy; and there are sometimes little touches which afford evidence of keen observation; the zoomorphs never degenerate into conventional patterns. Vegetable forms are rare.

Next follows the district about the delta of the Fly river. Here we have a free treatment of curved lines and spirals; also leaf designs; and, along with these, great skill in stone-carving.

Thirdly, comes the district bordering on, and behind, the Papuan gulf, from the delta of the Aird river to Cape Possession, marked by

circular spires which tend to pass into the square variety, and by the development of the meander pattern. Wooden belts are characteristic of the district, and the prevailing ornaments on them are conventionalised derivatives of human faces.

The fourth, which Mr. Haddon calls the Central district, is an extensive strip of territory, stretching from Cape Possession to Mullan's Harbour, and occupied by a variety of tribes. This division of the country is longest and best known, containing Port Moresby, the seat of government. It is marked by the prevalence of panels, which shows itself not only in the ornamentation of objects, but also in tattooing, which is largely practised by the women. The absence of human, and, in general, of animal, figures is a noticeable feature in the art of this region.

Fifthly, there is the Massim district, comprising the remainder of the south coast and the South-Eastern Archipelago, including the Louisiade, D'Entrecasteaux, and Trobriand groups of islands. Here curved lines abound; scrolls, spirals, loopcoils, and the guilloche are everywhere. Animal forms, which were not found in the Central district, reappear in this, the bird *motif* predominating. The art is on a higher plane as regards technique than in other districts; and there is a feeling for symmetry and a talent for adapting ornament to material which are not elsewhere seen in the same degree.

If we look at the inhabitants of these several districts from the Ethnological point of view, we shall be led to regard those toward the west of the Protectorate, whether on the mainland or in the islands, from Daudai to somewhere about Cape Possession, as Papuans, belonging to a race dark in colour, with frizzly hair, dolicocephalic, and rather small in stature. Notwithstanding these common physical characters, there are great diversities amongst the tribes, but, as a whole, they appear to be the aborigines of New Guinea. From Cape Possession to the furthest of the Louisiades, we find, mixed with Papuans in different degrees in different localities, what seems to be an immigrant population, more light-coloured than the Papuans. These people are sometimes spoken of as Malayans or Malayo-Polynesians; Mr. Haddon prefers to call them Melanesians, which implies their origin from the chain of islands off the east of New Guinea, extending to New Caledonia. He believes, however, in a more complex mixture than that of two races only. It is thought that Maiva, in the Central

district, is the extreme point reached by the Melanesian settlers. How far the artistic characteristics of the several districts along the coast are to be explained by racial origin is, I think, a question too complex for solution, at least in the present state of our knowledge.

Two notable facts may be mentioned respecting the art of the entire Protectorate—(1) picture-writing is unknown, and (2) celestial objects are not represented; it appears to be at a later stage of development that the heavenly bodies become interesting.

Mr. Haddon's memoir is not merely a monograph on the art of the tribes of the Protectorate; it is also a study of their character and condition from the anthropological and sociological points of view. The treatment of their art, indeed, leads naturally, in many instances, to a description of their customs. Thus, *à propos* of the instrument commonly known as the bull-roarer,[1] he gives an account of their remarkable mysteries and forms of initiation, which remind us of the more celebrated Greek institution, and recall Virgil's "procul, o procul este profani." And, in connexion with the masks which some of the natives adorn so elaborately, he describes the ceremonial dances in which this singular costume is worn.

Speaking of these populations generally, we may say that they are in the fetishistic state, in which, with religions of that type, co-exists the lax form of political organization which usually accompanies them, where personal qualities — ability, experience, and supposed supernatural powers—are the foundation of ascendancy, and hereditary chieftainship is unknown or is found only in rudimentary form. We must not, however, conceive of them as representing the primitive man. They stand, as Mr. Haddon says, on a very low rung of the ladder of civilization, but not by any means on the lowest. Not only is agriculture practised among them, but the potter's art is carried on to a large extent, especially by the women, and fleets of canoes are equipped to carry its products along the shore to distant places, where they are exchanged for sago. The tribes which are warlike in their habits are those which are most energetic and contain the finest men; and our just horror of cannibalism must not hide from us the fact that those who have this shocking practice amongst them are often, perhaps generally,

[1] On this instrument see Mr. Andrew Lang's interesting volume, "Custom and Myth."

among the most enterprising and intelligent, and even among the foremost in art. It appears to be certain that, at least in recent times, cannibalism has not been caused by a deficiency of ordinary food. It might be supposed that it arose from a sentiment of savage triumph over an enemy; and there is a passage in the "Iliad" where such a feeling seems to show itself as a survival, where Zeus says to Hera that the only way in which she could satiate her rage against Priam and the Trojans would be by eating them raw. But according to Mr. Haddon, it is connected with the idea that by devouring your enemy you make yourself possessor of his fighting qualities. Only some of the New Guinea tribes are cannibals; others are revolted by the practice. And this is a case of a general fact which is very striking—namely, that there are remarkable varieties, within very limited areas, in manners and in the state of social development. The tribes in many cases, without being hostile, have little or no communication with each other, and do not readily adopt each other's customs or learn each other's arts. Readers of Max Müller's Lectures will remember how he brings out the fact of the multiplicity of different languages spoken by neighbouring tribes, some of them insignificant in number.[1] The same thing is observed in New Guinea, and not with respect to language only, but to their manners and arts in general, in which they rarely borrow from without, but adhere, as I have already said, to their local traditions.

The view of savage life presented to us discloses a scene very different from that composed by the imagination of Rousseau and his school. Peace and harmony do not prevail; the terrible saying, *Homo homini lupus*, is often exemplified. We read of tribes exterminated, or driven from their homes and reduced to the condition of vagrants, by the attacks of their enemies; and there is amongst entire populations a dreadful sense of insecurity arising from the recurrent visits of head-hunters. Yet the people have many amiable traits; they are most affectionate to their children; they often exhibit a marked respect for their parents and the aged generally;[2] and they respond by gratitude and goodwill to efforts for their good, as is eminently shown by the immense influence and popularity in the

[1] First Series, Lect. II.

[2] See Chalmers and Gill: "Work and Adventure in New Guinea," pp. 113 and 243.

whole country acquired by the kindly and protective action of the well-known missionary, Chalmers.

No summary which I could offer would give an adequate idea of the wonderfully copious body of materials which Mr. Haddon has brought together for the illustration of his subject from every available source—from British and Continental museums, and printed books or essays. To appreciate the extent and accuracy of his studies it would be necessary to go carefully through his Memoir, and I can assure you that in so doing you will reap both pleasure and profit. He has produced an excellent study of a comparatively new subject, and has shown a philosophic spirit and much sagacity in handling it; and his work well deserves to take its place beside the other notable Memoirs which we have honoured with the academic laurel.

And now, having completed the agreeable task of reviewing—I hope with due appreciation—these selected products of the intellectual activity of our body, I have an equally pleasing duty of a more personal nature to discharge. At the next meeting I shall vacate the Presidential Chair, and shall ask my successor to take it in my stead. I cannot do so without first returning—as I now beg to do—my hearty thanks to the Academy for the cordial support I have received in the performance of my duties from all our members, and in particular from the council and officers. And I should certainly do less than justice if I did not express my special obligations to the Secretary of the Academy for his ever-ready co-operation and aid. I have had frequent occasion to appeal to his accurate knowledge of the history and traditions of the Academy, and he has always most liberally placed that knowledge at my disposal, and has often guided my action by his judicious counsels. Of his services as editor of our "Transactions" and "Proceedings," in bringing them out promptly and in attractive form, it is scarcely possible to speak too highly.

I will add only a few words respecting the general position and prospects of the Academy. I do not think that in recent years there has been any diminution of the activity of our members in the several fields we profess to cultivate. The large attendance at our meetings has shown the interest taken in our work. In entering on the Chair I expressed the hope that whilst mathematics would not lose their place amongst us, the physico-chemical and biological sciences would

come prominently forward during my term of office. With respect to at least the latter branch this hope has been amply fulfilled, and I trust the impulse already given will be maintained. A new series of investigations into the anthropology and social condition of the inhabitants of the more remote and less advanced districts of our island has been commenced, which is sure in the future to lead to important results. Several of our national monuments have been more thoroughly explored and more accurately described than ever before; and something has been done towards increasing the number of the ancient structures which have been taken under the care of the public, and will thus be saved from the consequences of violence or neglect. A steady effort has been made towards obtaining a more complete and effective exhibition of the treasures of our collection in the Museum of Science and Art. The edition of the Annals of Ulster is within measurable distance of completion. The preparation of the Book of Armagh for publication is well advanced; the Gospels, I was some time since informed, will be in type before the close of my presidency, and the entire printing is expected to be completed within the present year. The greatest of our enterprises in the field of Celtic literature—namely, the Irish Dictionary—continues to make progress; but it has been retarded by the limitation of our resources. A communication was made to me just before my election as President respecting a handsome contribution to our funds, in the shape of a sum left on trust to be devoted to this work, but the Academy has not received the gift. The exact nature of the communication, and the subsequent circumstances arising out of it, ought, of course, to be made known to the Council, and it will be my duty, before the end of my official term, to submit a statement of the facts to that body, with which will then rest the determination of the action to be taken in relation to the matter.

Within our house we have now collected portraits of many distinguished men who have sat in the Chair which I less worthily occupy. To speak only of those whom I have known in the course of my Academic experience—Hamilton, Robinson, Todd, Graves, Kane, Ferguson, Haughton, and Reeves now look down upon us from our walls. On those who will come after us the pictured presence of these intellectual ancestors must have an elevating and

inspiring influence. There are others I would gladly see represented in the group; and I commend to my fellow-Academicians the duty of thus perpetuating amongst us the memory of Humphrey Lloyd, of Jellett, and of Stokes.

There is a fine poem of Schiller's, well, though somewhat freely, translated by our own Clarence Mangan, in which, speaking to his fellow-countrymen at a time when Germany stood in several respects below the neighbouring nations, the poet owns this inferiority; we have not, he says, the material resources or the busy life of commerce, which others can boast; but there are things, he adds, which console us for our deficiencies—

> "Our hearts
> Are still the home of Science and the Arts,
> And glow and gladden in the light they give."

That is the hope I cherish for Ireland, that, though material wealth may be denied her, she may be rich in the things of the mind, that the bright intellect and the fine feeling of our people, duly cultivated and directed aright, may win back the early reputation of our country as a dwelling-place of peaceful study, and a centre of beneficent influence. And with this I join the further and kindred hope that this Academy, retaining its position as one of the foremost of Irish institutions, may long continue to be a home of high thought and graceful culture, where our successors will meet in friendly union, as we have done, to study, according to the three-fold design of our foundation, the truths of Science, the treasures of Literature, and the memorials of the past.

At the conclusion of the President's Address, His Excellency the Lord Lieutenant said—

Mr. President and gentlemen, I rise with some diffidence and with many misgivings to perform a duty which I believe is conferred on me by reason of the fact that, owing to the official position which I have the honour to hold, I am Visitor to this distinguished Academy. I have been requested to move a resolution in the following words:—

> "That the best thanks of this Academy are hereby given to the President for his address."

Now, gentlemen, it would be obviously futile on my part to attempt to lead you into a discussion on the personal merits of our

distinguished President, especially in his presence. I might, of course, remark that everyone in this room would be better qualified than I am, by long personal acquaintance with that distinguished man, to enlarge on his great abilities, and on the services which he has conferred on his country. But, although that may be so, it must be remembered that Dr. Ingram's reputation is world-wide. It is not necessary to have been a native or an inhabitant of Dublin or of Ireland in order to thoroughly realise what his qualifications are to enlist your admiration and your gratitude.

I may, perhaps, be allowed to remark very briefly on the admirable address which the President has delivered. He has, in his exhaustive remarks, referred to three different works of very eminent gentlemen, professors in Dublin, and there is very little left for me to add on these subjects, even if I were qualified to say anything on them. With regard to the first, that of Professor Cunningham, which deals with the subject of the anatomy of the cerebrum, for obvious physical reasons I am less interested in that subject than all of you distinguished gentlemen here present. With regard to the second subject—viz. the memoir written by Dr. Mahaffy on the Flinders-Petrie Papyri—a subject in which he has been such an energetic discoverer—there is only one remark I should like to make, and that is with reference to a sentence in the President's address, where he said:—

"On a general survey of these materials one broad general conclusion forces itself upon us—namely this, the handwritings, whether the literary or the less formal, show so much facility, boldness, and variety that plainly the practice of writing was quite common and habitual."

Now, gentlemen, the President said something about the ingenuity of Dr. Mahaffy's conjectures on various points which he discusses in his paper, but if Dr. Mahaffy or anyone else is bold enough to endeavour to arrive at any sound conclusion on the subject of handwriting by the fact that the "practice of handwriting is common and habitual," I can only say that, from my own experience, the merits of the handwritings of our fellow-men of the present day are in the exact inverse ratio to the amount of the practice in writing which they have had. If I had thought the subject was going to be discussed I think I could have brought here various specimens of letters which I have had the honour to receive within the last few weeks

which would puzzle even Dr. Mahaffy as to their origin and the date of their execution.

I pass on from that to what after all is at the present moment of the greatest interest to us. There is an *amari aliquid* which we must all feel in passing a vote of thanks to our distinguished President, because, as he has told us, within a very few days he is about to resign the presidential chair which he has adorned, and to ask a successor to fill his place. Again, I say, that probably no one is less qualified here than I am to properly enumerate the various services for which this Academy has to thank its distinguished President; but I do hope he will allow me to express my deep and sincere regret that we are about to lose him as President of the Irish Academy.

The President then passed on to some remarks on the subject of the general position and prospects of the Academy; and I think we may all say that, coming from so high an authority, these statements are eminently satisfactory to those who wish well to that distinguished society.

With regard to the most eloquent words with which the President concluded his address, he quoted some well known lines of Schiller's, in which the great poet, while owning the inferiority of his nation in matters of material prosperity, business, and commerce, yet declared that their hearts

> Are still the home of Science and the Arts,
> And glow and gladden in the light they give.

Well, I venture to think that the study and the consequent success of the culture of science and art in any country cannot be entirely divorced from the material resources, business, and commerce of this life. And, indeed, I notice that Dr. Haddon appears to be of the same opinion, for, in a passage quoted by the President, he says—

"It is observed that the abundance and richness of art is conditioned also by the material prosperity of the tribe. A poor miserable people has a poor miserable art. A certain freedom from the cares of life is necessary for æsthetic culture."

I believe that these two passages taken together sum up the conditions under which alone science and art can continue to thrive in any country. But I am not prepared to admit, as Schiller did of his country, that Ireland is to continue in a position of inferiority in

the matter of material resources, or of wealth and prosperity. I am sanguine enough to believe that we already see some symptoms of a distinct and decided and even a rapid improvement in the material prosperity of this country; and I trust, as I am sure you, gentlemen, all trust, that one of the first, and certainly one of the most important and one of the brightest results of such a return to prosperity would consist in the fact that those subjects in which you are deeply interested, and art and science generally, may receive an ever-increasing degree of material encouragement, without which it is impossible that they can be properly promoted. I hope that this Academy will long continue to foster the studies which it has so nobly encouraged; and I cannot conclude with any better or higher wish than this—that Ireland may never be wanting in distinguished sons like our President, who has spent an illustrious life in the culture of these scientific, literary, and artistic pursuits, the development of which is the real object of the foundation and existence of this great Academy.

Sir John Banks seconded the resolution, and said—

I esteem it a very great honour to have been asked to second this vote of thanks, following his Excellency, who has proposed it in such graceful and gracious terms. The Royal Irish Academy has since its foundation been fortunate in having for its Presidents men of whom Ireland may well be proud. The president has spoken of some of his immediate intellectual predecessors, and I am sure we are all happy to see here this evening two of those intellectual predecessors, my honoured friends Dr. Graves the Lord Bishop of Limerick and Dr. Haughton. To the names that the President has mentioned I would venture to add the great names of Charlemont, Brinkley, and Bartholomew Lloyd. The President says that he less worthily fills the chair which has been filled by his predecessors ; now, I venture to say that the unanimous vote of the Academy would tell that he well and worthily fills it, and that the name of Ingram will be added to the roll of illustrious Presidents.

The President has spoken of the portraits that look down upon us from these walls; and I should like to say that the best portraits are the portraits of the Bishop of Limerick and Dr. Haughton. And the cause is not far to seek. The accomplished artist had the

living men before her, the others were done from photographs. I would, therefore, throw out the suggestion to the Members of the Academy that the portrait of the President—of him who so worthily fills the chair—should be painted from the life, and not left to our successors at some, I trust very remote, period to have it taken from a photograph.

I need not say with what very great pleasure I second the vote of thanks to the President for his address, which has been proposed by the Lord Lieutenant. His Excellency, in honouring the Academy with his presence here this evening, is performing one of the many and multifarious duties, and, I trust, not the least pleasing, that appertain to his high office; for under the Royal Charter by which the Academy was formed the post of Visitor was assigned to the Chief Governor of Ireland.

The Lord Lieutenant in putting the resolution, said—

I am asked to perform the very unnecessary duty of putting the resolution to the Meeting. I will not do it in the ordinary form, for I see it is the wish of everyone that the resolution should be carried with acclamation.

The President, in acknowledging, said—

I thank your Excellency for the very kind expressions which fell from you respecting me; and I also thank Sir John Banks for what he was good enough to say, though I fear what he said was rather dictated by his friendship for me than by any merits which I may have. I wish also to thank your Excellency on the part of the Academy. As has been mentioned by yourself and Sir John Banks, you are, by virtue of the high office which you fill in this country, Visitor of the Academy. You have not allowed that title to remain a dead letter. You have, as I know, inspected our antiquarian collections in the Museum of Science and Art; and on this occasion you have had the gracious thought of coming amongst us on the occasion of one of our meetings, and personally taking part in our proceedings. In the name of the Royal Irish Academy, I beg to tender to your Excellency our respectful thanks.

MONDAY, MARCH 16, 1896.

(STATED MEETING.)

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Colonel G. T. Plunkett and Mr. C. Litton Falkiner signed the Roll, and were admitted Members of the Academy.

The President declared the ballot open for the election of President and Council for the coming year, and for the election of Honorary Members.

Dr. J. T. Gilbert proposed, and Professor G. F. Fitz Gerald seconded, the Earl of Rosse, K.P., for the office of President.

Master Pigot and Mr. J. E. Gore were appointed Scrutineers of the ballot for President and Council, and the Treasurer and Secretary of the ballot for Honorary Members.

The Secretary of Council read the following

REPORT OF THE COUNCIL FOR THE YEAR 1895–96.

Since the date of the last Report the following Publications of the Academy have been issued:—

Transactions, vol. XXX.

Part 16. "The Theory of Linear Vector Functions." By Charles J. Joly, M.A., F.T.C.D.

Part. 17. "On the Cytology of the Vegetative and Reproductive Organs of the Saprolegnieæ." By Marcus Hartog, M.A., D.SC., Professor of Natural History, Queen's College, Cork.

The Todd Lecture Series.

Vol. VI. Rev. Edmund Hogan, S.J., F.R.U.I.: "The Irish Nennius from L. na Huidre and Homilies and Legends from L. Brecc." Alphabetical Index of Irish Neuter Substantives.

Proceedings.

Of the *Proceedings*, Third Series, Part 4 of Vol. III., was published in December, 1895, and contained the following Papers:—

"On a Pandean Pipe from Tanna Island, New Hebrides." By Professor J. P. O'Reilly, and E. E. Fournier d'Albe.

"On the Crystalline Form of Riebeckite." By W. J. Sollas, LL.D., D.SC., F.R.S., Professor of Geology and Mineralogy in the University of Dublin.

"Note on Defective Vision and other Ocular Derangements in Cornelius Magrath, the Irish Giant." By H. R. Swanzy, A.M., M.B., F.R.C.S.I.

"Three Poems in Middle-Irish, relating to the Battle of Mucrama." With English Translation and Notes, and a short Vocabulary. By John Mac Neill, B.A.

"The Oratory of Gallerus." By Rev. Thomas Olden, M.A.

"On the Position of Encke's Comet, as deduced from Photographs taken by Mr. W. E. Wilson." By Arthur A. Rambaut, D.SC. F.R.A.S., Royal Astronomer of Ireland.

"On the Orientation of Certain Dolmens recently discovered in Catalonia." By Professor J. P. O'Reilly.

"Quartz, Quartz-Rock, and Quartzite." By George Henry Kinahan.

"The Ethnography of the Mullet, Inishkea Islands, and Portacloy, County Mayo." By Charles R. Browne, M.D.

"Third Report on the Prehistoric Remains from the Sandhills of the Coast of Ireland." By W. J. Knowles.

"On the Rotifera of the County Mayo." By John Hood, F.R.M.S., Dundee.

"On the Chromosomes of *Lilium longiflorum*." By H. H. Dixon, B.A., Assistant to the Professor of Botany, Trinity College, Dublin.

"Note on the Nuclei of the Endosperm of *Fritillaria imperialis*." By H. H. Dixon, B.A.

The following Publications are in the Press:—

Part 18.—"On a Volcanic Neck, of Tertiary Age, in the county of Galway." By Professor Sollas, D.SC., F.R.S., and A. Mc Henry.

Part 19.—"On Scalar Invariants of two Linear Vector Functions." By Charles J. Joly, M.A., F.T.C.D.

Part 20.—"On Species of *Phoxocephalus* and *Apherusa*." By W. T. Calman, B.SC., University College, Dundee.

The following Science Grants, recommended by the Council, have been sanctioned by the Academy:—

£45 to a Committee, consisting of Dr. R. F. Scharff, Dr. E. J. Mc Weeney, Professor T. Johnson, Messrs. R. L. Praeger, R. M. Barrington, G. Pim, G. H. Carpenter, R. J. Ussher, F. W. Moore,

D. McArdle, A. R. Nichols, and Professor E. P. Wright, to assist them in continuing their Researches into the Fauna and Flora of Ireland.

£20 to a Committee consisting of Rev. Dr. Haughton, Professor D. J. Cunningham, Professor A. C. Haddon, and Dr. C. R. Browne, to assist them in carrying on the work of the Anthropometrical Laboratory, and the Ethnographical Survey of the remote districts of Ireland.

£20 to Dr. J. T. Gilbert, to assist in the preparation of a Bibliography of the Works of Irish Authors, from the 15th to the 18th century, especially of many rare and valuable works published on the Continent.

£10 to Mr. G. Coffey, to assist him in a Systematic Investigation of the Irish Sepulchral Urns.

£5 to Professor W. J. Sollas and Mr. R. L. Praeger, to assist them in investigating the Glacial Deposits of Central Ireland.

The following Members have been elected since 16th March, 1895:—

Francis Elrington Ball.
Patrick J. Barry, L.R.C.S.I., L.K.Q.C.P.I.
Ramsay Colles.
Samuel William Percy Cowan, M.A.
Cæsar Litton Falkiner, M.A.
Rev. William Spotswood Green, M.A.
Hubert Thomas Knox.
Lieut.-Colonel Thomas Ainslie Lunham, M.A.
Rev. James Edward Harnett Murphy, M.A.
Rev. Hugh O'Reilly.
Lieut.-Colonel George T. Plunkett, F.R.G.S.

At the Stated Meeting, on the 16th March, 1895—

Karl Weierstrass,
Emil Heinrich Du Bois-Raymond,
Eduard Suess,

were elected Honorary Members in the Section of Science.

And—

Adolf Erman,
Eduard Zeller,
Lieut.-General Augustus H. L. F. Pitt Rivers,
Samuel Rawson Gardiner,

in the Section of Polite Literature and Antiquities.

The Academy has lost by death within the year thirteen Members:—

Valentine Ball, LL.D., C.B., F.R.S., elected 11th June, 1883.

Most Rev. Michael Comerford, D.D., elected 13th February, 1882.

William John FitzPatrick, LL.D., F.S.A., elected 11th January, 1875.

Robert Galloway, F.C.S., elected 13th May, 1878.

Rev. James Goodman, M.A., elected 22nd June, 1885.

Right Hon. George Stephens, Viscount Gough, M.A., D.L., elected 25th May, 1836.

Thomas Maxwell Hutton, D.L., elected 11th June, 1866.

Maurice Lenihan, elected 12th April, 1869.

Alexander Goodman More, F.L.S., elected 9th April, 1866.

Very Rev. Francis O'Brien, elected 12th December, 1887.

Dixon Cornelius O'Keeffe, M.A., elected 12th May, 1890.

Sir George Hornidge Porter, Bart., M.D., elected 11th January, 1875.

Robert George Watts, M.D., F.R.S.L., elected 10th January, 1881.

The Academy has also lost by death three Honorary Members in the Section of Science:—

James Dwight Dana, elected 15th March, 1873.

Right Hon. Thomas Henry Huxley, elected 16th March, 1874.

Louis Pasteur, elected 16th March, 1878.

And one Honorary Member in the Section of Polite Literature and Antiquities:—

George Stephens, elected 15th March, 1884.

Of the "Annals of Ulster," vol. iii., completing the Text and Translation, has been published, and the Editor, Rev. Dr. Mac Carthy, is engaged in the preparation of an Index to the work which it is hoped will be published, together with the Preface and Introduction, during the incoming Academic year.

The Council have to regret that in September, 1895, Mr. W. J. Purton was compelled from ill-health to resign his position as Assistant to the Editor of the "Irish Dictionary," and his place has not yet been filled up.

The photolithography of the "Yellow Book of Lecan" is now finished, and the work will be published immediately.

On the 22nd of January the Committee appointed for that purpose held their Annual Visitation of the Academy's Collections in the Museum of Science and Art, and their Report has been duly presented to the Council. The most important matter included therein had reference to the urgent necessity for increased space. The two rooms originally allocated to the Academy's Collections have been found by experience to be quite insufficient for their display; the Council, however, hope that in a short time considerable additional accommodation will be provided.

The following are the principal additions to the Academy's Museum during the year:—

Prehistoric stone and flint implements recently found in the sandhills on the Northern Coasts of Ireland.

Flint arrow-heads from county Londonderry.

Sandstone cup from county Antrim.

Iron broadsword found at Murgasty Hill, county Tipperary.

A series of encaustic floor-tiles from the Church of SS. Peter and Paul, Trim.

Silver wheel-brooch, with amber settings, found in 1875 between Edenderry and Philipstown.

Wheel-brooch of "findruin" with jewel settings.

Silver mediæval fibula, embossed, found near St. Mary's Abbey, Trim.

Silver goblet, with engraved ornamentation, found in the ruins of St. Mary's Abbey, Trim.

Silver-plated copper breastplate, with inscription.

Copper celt from county Antrim.

Five gold penannular objects, with decorated cup-extremities, from county Waterford. (Deposited by W. G. D. Goff, Esq.)

The Library during the past year has received some interesting donations. A considerable amount of bookbinding has been executed, especially in connexion with the publications of learned Societies, access to which has thus been much facilitated to those engaged in research. The revision of the catalogue of printed books has also been continued.

By the death of Mr. A. G. More the zoologists and botanists of Ireland have lost an authority in whom they almost implicitly relied

on the subject of the determination of Irish birds and plants. His "List of Irish Birds" (1885) and the "Cybele Hibernica" (published in conjunction with Dr. David Moore in 1866) may be regarded as types of the kind of work in which he excelled; careful and accurate studies furnishing an admirable basis for the future progress of scientific investigation in these branches of knowledge.

In 1867 Mr. More was appointed Assistant in the Natural History Museum, Dublin, and in 1881, on the death of Dr. Carte, he was appointed Curator of the Natural History Department of the Museum of Science and Art, a post which he occupied till his retirement from ill health in 1887. His labours in immediate connexion with the Academy were confined to the preparation of Reports on the Flora of Ireland, which appear in the *Proceedings*, *Royal Irish Academy*, Second Series, vol. II., p. 256 sqq., and p. 553 sqq. The Academy elected him a Member of its Council in 1883, which he continued to be until his retirement, from ill health, in 1887.

In the death of V. Ball (born 1843, died 1895) the Academy has lost one of its most respected Members, and one of its most zealous friends. The great change in the removal of the priceless Antiquarian treasures from the Academy House, to the new Science and Art Museum, could not have been effected under a Director more acquainted with their value, or more kindly disposed to the body that had consented to their deposit in the new building. The direction of a great Museum was a field peculiarly fitted to Dr. Ball's wide experience, gained in no mere library study, but in the course of a life of constant and varied labour. His appointment on the Geological Survey of India, in 1864, introduced him into a wide sphere of opportunities, of which he was prompt to take advantage, as his numerous writings prove. For not only were his special duties as Geological Surveyor performed in a manner that steadily increased his reputation, but his keen trained eyes enabled him to utilize his rare opportunities in many other spheres of knowledge; he devoted much attention to the birds of India, wrote much and well on the multifarious products of the jungle, and attracted the notice and interest of students of anthropology by his observations on the characteristics and peculiarities of the native tribes of India with whom he came into contact, and with whom he was specially fitted to deal by his promptness and resourcefulness in action, and by his warm and constant sympathy. His more especial work as a

geologist was so highly valued, that the University of Dublin appointed him as its Professor of Geology and Mineralogy in 1881, on the resignation of that chair by Rev. Dr. Haughton. This post Dr. Ball filled with distinction, but he held it only for a short space of time, for within two years, the very congenial position of Director in the National Museum was conferred on him, and to the task of developing this Museum he addressed himself with his energy and singleness of heart. Yet he never lost sight of his old studies, and wrote many papers on the various branches of science on which he possessed special knowledge, some of which have appeared in our *Transactions* and *Proceedings*.

Of the general excellence of his work, the best guarantee is to be found in his election to the Royal Society of London, in 1882, and in the honorary degree of Doctor of Laws, which was conferred on him by the University of Dublin, in 1889. With most of the Scientific Societies of Dublin he stood in close and intimate relation. He was for many years the Secretary of the Royal Zoological Society of Ireland, and took a deep interest in its maintenance and prosperity. In 1886 he was elected to the Council of the Royal Irish Academy, and held his seat as Member of Council till his death, which took place on June 15, 1895.

The following Papers by Dr. V. Ball were published by the Academy:—

Transactions.

1886.—"Observations on Lion-breeding in the Gardens of the Royal Zoological Society of Ireland."

1893.—"On a block of Red Glass Enamel said to have been found at Tara Hill." (A joint Paper with Margaret Stokes).

Proceedings.

1883.—"On some Brass Castings of Indian Manufacture."

1884.—"On the Identification of the Animals and Plants of India which were known to early Greek Authors."

1887.—"Further Notes on the Identification of the Animals and Plants of India which were known to early Greek Authors."

1890–91.—"A Commentary on the Colloquies of Garcia de Orta on the Simples, Drugs, and Medicinal Substances of India." (Parts I. and II.)

1893.—"On the Volcanoes and Hot Springs of India and the Folk-Lore connected therewith."

1894.—"A description of two large Spinel Rubies with Persian Characters engraved upon them."

The Secretary, for Mr. W. F. Calman, B.SC., read a Paper on "Some Deep-sea Crustacea from the South-West of Ireland." [Communicated by Dr. E. P. Wright.]

Mr. George Coffey exhibited:—

1. "A full-sized Drawing of an Inscribed Stone at New Grange, Co. Meath."

2. "Photographs of objects from the 'Dowris Find,' King's County, in the Collection of the British Museum."

On the Report of the Scrutineers the President declared the following duly elected:—

PRESIDENT.

THE EARL OF ROSSE, K.P., F.R.S.

COUNCIL.

Committee of Science.

Edward Perceval Wright, M.D.
Francis A. Tarleton, LL.D.
Benjamin Williamson, D.SC., F.R.S.
J. P. O'Reilly, C.E.
George L. Cathcart, M.A.
George Henry Kinahan, C.E.
Rev. Samuel Haughton, M.D., F.R.S.
William J. Sollas, D.SC., F.R.S.
Robert F. Scharff, B.SC., PH.D.
Arthur A. Rambaut, M.A., D.SC.
Greenwood Pim, M.A.

Committee of Polite Literature and Antiquities.

Robert Atkinson, LL.D.
Rev. Maxwell H. Close, M.A.
John T. Gilbert, LL.D., F.S.A.
William Frazer, F.R.C.S.I.
Rev. Denis Murphy, S.J., LL.D.
Louis C. Purser, M.A., LITT.D.
Most Rev. Bishop Donnelly, D.D.
Lord Walter FitzGerald.
Rev. J. H. Bernard, D.D.
John Kells Ingram, LL.D.

On the Report of the Scrutineers, the following were declared duly elected as Honorary Members:—

In the Section of Science.

William Ramsay, F.R.S.
Rev. Thomas George Bonney, F.R.S.
Sir William Flower, K.C.B., F.R.S.

And Sir Joseph Lister, Bart., President of the Royal Society, was proclaimed an Honorary Member under By-Law 14, Chapter II.

The ballot was opened for the election of Officers, and, on the Report of the Scrutineers, the following were declared duly elected:—

TREASURER—Rev. M. H. Close, M.A.
SECRETARY—Ed. Perceval Wright, M.D.
SECRETARY OF THE COUNCIL—Robert Atkinson, LL.D.
SECRETARY OF FOREIGN CORRESPONDENCE—Joseph P. O'Reilly, C.E.
LIBRARIAN—John T. Gilbert, LL.D.
ASSISTANT SECRETARY—Robert Macalister, LL.B.

The Academy then adjourned.

MONDAY, APRIL 13, 1896.

MASTER PIGOT, M.A., in the Chair.

Right Hon. Christopher Talbot Redington, D.L.,
Rev. Henry William Lett, M.A.,
John Merrick Head, F.R.G.S.,
William Alexander Craig,
Rev. Joseph McKeefry,
Edward John Gwynn, M.A., F.T.C.D.,
Alexander Charles O'Sullivan, M.A., F.T.C.D.,

were elected Members of the Academy.

Mr. F. W. Moore read a Paper by Mr. David McArdle on "A further List of Hepaticæ from the Hill of Howth."

Mr. T. J. Westropp, M.A., read a Paper on "The Mound of Magh Adhair, Co. Clare."

Dr. Frazer exhibited illustrations of croziers, decorated with "Limoges enamel," Irish and foreign.

Read the following letters:—

"12, PARK CRESCENT,

"PORTLAND-PLACE,

"25*th March*, 1896.

"DEAR SIR,

"I have received your letter and the accompanying certificate. I beg you to express to the Royal Irish Academy my gratification at the fact that my position as President of the Royal Society involves the high distinction of the Honorary Membership of the Academy.

"I am,

"Very sincerely yours,

"JOSEPH LISTER.

"Professor PERCEVAL WRIGHT, M.D., &c."

"23, Denning-road,
Hampstead, N.W.,
March 26th, 1896.

"Sir,

"To be elected to the Honorary Membership of a body so eminent as the Royal Irish Academy is a distinction of which any man might well be proud. It is one of which I cannot presume to think myself worthy, and I feel that I owe it more to the lenient judgment of friends than to my own deserts. It shall, however, incite me, during the time that may remain for work, to do all that I can to show myself less unworthy of it.

"May I ask you to convey to the proper quarter my very grateful thanks for and acceptance of this most unexpected but most welcome honour.

"I am, Sir,
"Your obedient servant,
"T. G. Bonney.

"Prof. Perceval Wright, M.D.,
"Sec. R.I.A."

"12, Arundel Gardens,
"London, W.,
"*March 28th*, 1896.

"My Dear Sir,

"I have to acknowledge, with thanks, your letter of the 24th March, informing me of my election as Honorary Member of the Royal Irish Academy in the Section of Science. Would you be so good as to convey to the Academy my deep sense of the honour they have done me, and my warm thanks. Such a recognition should be, and I hope it will be with me, an incentive to future work.

"Yours faithfully,
"William Ramsay.

"Ed. Perceval Wright, Esq., M.D.,
"Dublin."

"BRITISH MUSEUM (NATURAL HISTORY),

"CROMWELL-ROAD,

"SOUTH KENSINGTON, S.W.,

"31*st March*, 1896.

"MY DEAR WRIGHT,

"I have much pleasure in acknowledging the receipt of your letter of the 24th instant, informing me that the Royal Irish Academy has elected me an Honorary Member in the Section of Science, and enclosing the certificate thereof.

"May I ask you to take the first opportunity of assuring your colleagues in the Academy that the distinction they have thus conferred upon me is one that I value very highly indeed; and that I feel deeply their great kindness to me in thus rewarding, in such a marked way, the small services that I have been able to render to Science.

"It is an additional pleasure to have had the intimation of this honour conveyed to me by the hand of such an old friend as yourself.

"Believe me to be

"Most truly yours,

"W. H. FLOWER.

"To DR. E. PERCEVAL WRIGHT,

"Secretary to the Royal Irish Academy, &c."

The names of Vice-Presidents nominated under the hand and seal of the President, on 23rd March, were read:—

THE REV. SAMUEL HAUGHTON, M.D.

THE MOST REV. NICHOLAS DONNELLY, D.D.

JOHN KELLS INGRAM, LL.D.

BENJAMIN WILLIAMSON, SC.D.

Donations to the Library were announced and thanks were voted to the Donors.

Read the following letter :—

"JUBILEE OF THE RIGHT HONOURABLE PROFESSOR LORD KELVIN.

"GLASGOW, 10*th March*, 1896.

"SIR,

"In the autumn of this year the Right Honourable Lord Kelvin completes the fiftieth year of his tenure of the Chair of Natural Philosophy in the University of Glasgow. An event so rare in academic history naturally calls forth the heartiest congratulations of the University and the City; but, in view of his pre-eminent position as a man of science, it has been thought fitting that other bodies, who have already testified their appreciation of Lord Kelvin's distinction by enrolling his name among their members, should be invited to take part in the proceedings with which it is proposed to celebrate the Jubilee of his Professorship.

"We are desired by the Committee charged with the arrangements to intimate that the University and the Municipality would be gratified by your appointing a representative to take part in the celebration to be held here on the 15th and 16th of June next. Be so good as send to Professor Stewart, Clerk of Senate, The University, Glasgow, not later than 10th April, the name and address of your representative, in order that a formal invitation may be forwarded to him.

"We have the honour to be,

Sir,

"Your obedient servants,

"JOHN CAIRD,

"*Principal and Vice-Chancellor of the University.*

"JAMES BELL, BART.,

"*Lord Provost of Glasgow.*

"THE SECRETARY,

"Royal Irish Academy, Dublin."

Resolved: That the President (THE EARL OF ROSSE, K.P., LL.D.) be invited to represent the Academy on this occasion.

MONDAY, APRIL 27, 1896.

DR. J. K. INGRAM, S.F.T.C.D., Vice-President, in the Chair.

The Right Hon. C. T. Redington and W. A. Craig signed the Roll and were admitted Members of the Academy.

The following were elected Representatives of the Academy on the Board of Visitors of the Science and Art Museum, &c., Dublin, for the next five years:—

JOHN RIBTON GARSTIN, LL.B.
REV. DR. HAUGHTON, F.R.S.
DR. E. PERCEVAL WRIGHT.

Dr. W. Frazer read a Paper on "Gold Lunulæ found in Ireland."

Donations to the Library were announced, and thanks were voted to the Donors.

The Treasurer laid on the table the audited Accounts for 1895–6, and an Estimate of the Receipts and Expenditure for 1896–7.

MONDAY, MAY 11, 1896.

DR. J. K. INGRAM, S.F.T.C.D., Vice-President, in the Chair.

Rev. Daniel F. M'Crea was elected a Member of the Academy.

Dr. Charles R. Browne read a "Report on the Ethnology of Ballycroy, county of Mayo."

Part 20 of Volume XXX. of the *Transactions*, "On Species of Phoxocephalus and Apherusa": by W. T. Calman, B.SC., was laid on the table.

MONDAY, JUNE 8, 1896.

DR. J. K. INGRAM, S.F.T.C.D., Vice-President, in the Chair.

Thomas George Hennis Green was elected a Member of the Academy.

Mr. Charles J. Joly, M.A., F.T.C.D., read a Paper on "Quaternion Invariants of Linear Vector Functions and Quaternion Determinants."

By permission of the Academy, Mr. H. H. Dixon, B.A., read a Paper on "The Osmotic Pressures in the Cells of Leaves."

Donations to the Library were announced, and thanks were voted to the Donors.

The following Science Grants, recommended by the Council, were sanctioned by the Academy:—

£40 to a Committee, consisting of Dr. R. F. Scharff, Dr. E. J. McWeeney, Professor T. Johnson, Messrs. R. L. Praeger, G. Pim, G. H. Carpenter, F. W. Moore, A. R. Nichols, G. E. H. Barrett-Hamilton, R. J. Ussher, and D. McArdle, to assist them in continuing their Researches into the Fauna and Flora of Ireland.

£25 to a Committee consisting of Rev. Dr. Haughton, Professor D. J. Cunningham, Professor A. C. Haddon, and Dr. C. R. Browne, to assist them in carrying on the work of the Anthropometrical Laboratory, and the Ethnographical Survey of the remote districts of Ireland.

£20 [as a supplemental Grant] to a Committee consisting of Mr. R. M. Barrington, Professor A. C. Haddon, Rev. W. S. Green, Mr. R. Ll. Praeger, and Professor E. P. Wright, to assist them in investigating the Zoology, Botany, and Geology of the Island of Rockall, and to dredge in its vicinity.

£10 to a Committee consisting of Messrs. W. J. Knowles, R. Ll. Praeger, W. H. Patterson, and F. J. Bigger, to assist them in investigating the Prehistoric remains in the neighbourhood of Roundstone, and on the sea-shore along Mannin and Ballyconneely Bays.

£5 to Professor G. F. FitzGerald, and Mr. E. Cullum, to assist them in carrying on a series of Magnetic Observations at Valentia.

The Treasurer, in accordance with By-law 3, Chapter III., read a List of Members in arrear.

Count Plunkett handed in the following Notice of Motion for the next meeting of the Academy:—

"To move that: Inasmuch as it is inexpedient that the Academy should commit itself to certain expressions of opinion contained in pages 3 and 4 of the Preface to the Yellow Book of Lecan, Dr. Atkinson be requested to cancel these passages.

"GEORGE NOBLE PLUNKETT."

MONDAY, JUNE 22, 1896.

Right Hon. THE EARL OF ROSSE, K.P., F.R.S., President, in the Chair.

The President announced that he had, on behalf of the Academy, attended at the celebration of the Jubilee of Lord Kelvin's Professorship of the Chair of Natural Philosophy in the University of Glasgow.

Rev. John Hammond, D.D., was elected a Member of the Academy.

Rev. W. S. Green, M.A., gave a short account of the expedition to Rockall—made during the present month.

Professor J. P. O'Reilly, C.E., read a Paper on "The Orientation of Three Cromleachs in the vicinity of the city of Dublin."

Dr. J. T. Gilbert read "Notes on Irish Bibliography: notices on Books by Irish writers, or in connexion with Ireland, printed before A.D. 1600."

Dr. W. Frazer read a "Note on some Roundells of the time of Elizabeth, lent for exhibition by Sir Frederick Shaw, Bart."

Donations to the Library and Museum were announced, and thanks were voted to the Donors.

Visitors having withdrawn,

Count Plunkett moved the following, of which he had given notice:—

"That, inasmuch as it is inexpedient that the Academy should commit itself to certain expressions of opinion contained in pages 3 and 4 of the Preface to the Yellow Book of Lecan, Dr. Atkinson be requested to cancel these passages."

This was seconded by Dr. Douglas Hyde.

The following Amendment was moved by Dr. E. P. Wright, and seconded by Dr. P. W. Joyce:—

"That the following be printed and affixed to each copy of the Yellow Book of Lecan:—

"'The Academy desire it to be understood that they are not answerable for any opinion, representation of facts, or train of reasoning that may appear in any of the Academy's publications.'"

The Amendment was carried, and subsequently put and carried as a substantive Resolution.

MONDAY, NOVEMBER 9, 1896.

Right Hon. THE EARL OF ROSSE, K.P., F.R.S., President, in the Chair (and afterwards Most Rev. Bishop Donnelly, D.D., Vice-President).

Dr. R. F. Scharff read a Paper on "The Origin of the European Fauna."

Professor G. F. Fitz Gerald, F.R.S., read a Paper by Mr. Ralph Cusack on "The Melting Points of Minerals."

A Paper by Sir Robert Ball, F.R.S., "Further Development of the relations between Impulsive Screws and Instantaneous Screws; being the Eleventh Memoir on the Theory of Screws," was taken as read.

Dr. W. Frazer read a Paper on "Irish Gold."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, NOVEMBER 30, 1896.

(STATED MEETING.)

Right Hon. THE EARL OF ROSSE, K.P., F.R.S., President, in the Chair.

Mr. John Ribton Garstin, M.A., B.D., F.S.A., was elected a Member of Council in the room of Rev. Denis Murphy, S.J., deceased.

Professor O'Reilly read a Paper "On the Orientation of the Cromleachs of Mount Venus, Larch Hill, and Shankill, co. Dublin."

Rev. W. S. Green, M.A., read an account of the two Expeditions made to Rockall in 1896.

This was accompanied by the following supplemental Reports: "On the Previous History of the Rock and Shoal," by Professor Rupert Jones, F.R.S.; "On the Petrology of the Rock," by Professor J. W. Judd, C.B., F.R.S.; "On the Pebbles dredged near the Rock by Professor Grenville A. J. Cole, F.G.S.; "On the Winds and Currents in the neighbourhood of the Rock," by R. H. Scott, F.R.S.; "On the Surface Water near the Shoal," by H. Dickson; "On the Birds," by J. Harvie Brown, F.Z.S.; and R. M. Barrington, LL.B., F.L.S.; "On the Mollusca," by A. R. Nichols; "On the Crustacea," by W. T. Calman and Dr. E. P. Wright; "On the Annelids," by Professor M'Intosh, F.R.S.; "On the Echinoderms," by Percy Sladen; "On the Polyzoa, Actinozoa, and Hydrozoa," by Miss Thornley and Professor A. C. Haddon, D.SC.; "On the Sponges," by Dr. Lindenfeld.

Donations to the Library were announced, and thanks were voted to the Donors.

The following Notice of Motion was handed in :—

"Professor G. F. Fitz Gerald to move :—

"That it be recommended to the Council to consider the advisability of altering By-law 2 of Chapter IX., so that the days on which ordinary General Meetings of the Academy shall be held shall be Wednesdays, instead of Mondays, as at present."

MONDAY, DECEMBER 14, 1896.

Right Hon. THE EARL OF ROSSE, K.P., F.R.S., President, in the Chair.

Mr. Charles J. Joly, M.A., F.T.C.D., read a Paper on "Vector Expressions for Curves."

By permission of the Academy, Mr. A. Vaughan Jennings, F.L.S., read a Paper on "A new genus of Bacteria, showing Longitudinal Fission (Astrobacteria)."

Professor George F. Fitz Gerald, SC.D., F.R.S., moved the following, of which he had given notice :—

"That it be recommended to the Council to consider the advisability of altering By-law 2 of Chapter IX., so that the days on which ordinary General Meetings of the Academy shall be held shall be Wednesdays, instead of Mondays, as at present."

The motion was seconded by Earl Belmore, G.C.M.G., and adopted.

MONDAY, JANUARY 11, 1897.

MR. JOHN RIBTON GARSTIN, M.A., F.S.A., D.L., in the Chair.

Edmond Johnson and Thomas Preston, M.A., F.R.U.I., were elected Members of the Academy.

The Secretary read "A Note on the Death of Dathi, King of Ireland." by Mr. H. T. Knox.

Mr. C. J. Joly, M.A., F.T.C.D., read a Paper, "Note on Spherical Nets."

Mr. G. Coffey exhibited some recent Finds from Portstewart and Whitepark Bay.

The Secretary exhibited a Collection of Bronze, Iron, &c., Objects, recently acquired for the Museum.

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY JANUARY 25, 1897.

DEPUTY SURGEON-GENERAL H. KING, M.A., M.B, in the Chair.

Professor A. C. Haddon, M.A., D.SC., read a Paper, "Studies in Irish Craniology: III. A Neolithic Cist Burial near Drogheda."

The Secretary read a "Note on Crannoges in the County of Mayo," by Mr. H. T. Knox.

MONDAY, FEBRUARY 8, 1897.

RIGHT HON. THE EARL OF ROSSE, K.P. F.R.S., President, in the Chair.

Rev. G. T. Stokes, D.D., read a Paper, "On an original Indulgence issued by Cardinal Wolsey, and certain other Literary Finds lately made in Marsh's Library."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, FEBRUARY 22, 1897.

REV. DR. HAUGHTON, M.D., F.R.S., Vice-President, in the Chair.

Sir John Banks, K.C.B., M.D., in presenting to the Academy on behalf of the Subscribers an oil portrait (by Miss S. H. Purser, Hon. R.H.A.) of John Kells Ingram, LL.D., S.F.T.C.D., President of the Academy, 1892–6, said—Sir, on the 24th February of last year a vote of thanks was proposed by his Excellency the Lord Lieutenant, our Visitor, to our retiring President, Dr. Ingram, for the able address which he that day delivered. I had the honour of seconding that vote of thanks, and I then took the liberty of throwing out the suggestion that some memorial of Dr. Ingram's presidency should be effected, and that probably the best form would be a portrait to take its place with those of some of his illustrious predecessors. Owing to that suggestion a Committee was formed of a few of Dr. Ingram's personal friends, and a circular was sent round to the Members of the Academy asking them to subscribe. So ready was the response that ample funds were forthcoming before the Academy closed for the recess. The next step was to request Dr. Ingram to sit for his portrait, and he was also asked to name the artist. You have now before you the

work of that accomplished artist, Miss Purser, and it is my very pleasant duty on the part of the subscribers to offer the portrait to the Academy through you. It is not my intention to speak of the distinguished career of Dr. Ingram, but I think I may be permitted to say a few words with regard to his connexion with the Academy, to the admirable work he has done in the Academy, and to the great benefits he has conferred on it. In the year 1847 Dr. Ingram became a Member of the Academy, and it may, sir, possibly have escaped your memory that you were one of his proposers. In 1856 he became a Member of the Council, a position which he has held, I believe, almost without intermission from that time to this. In 1860 he was elected to the important office of Secretary of Council—an office so important that I believe the Secretary of the Council is considered the brains-carrier of the Council—and the mouthpiece of the governing body. 1847, the year in which Dr. Ingram entered the Academy, was a year disastrous to the country, but rich in gain to this Academy; for then M'Cullagh, the Lloyds, Rowan Hamilton, and Petrie were at the height of their fame, soon to be followed by younger men, by Graves, by Salmon, by Haughton, by Kane, by Ferguson, and others. Now, in proposing that this portrait of Dr. Ingram should be painted, I said it was desirable that it should be painted from the living man, and not from photographs, as some others have been painted, and that we the present men should not leave it to our successors to have it painted from photographs. It is a great justification to us to have the opportunity of contrasting the living man with his likeness. Passing from the present to the future, I may say it will be a great matter of interest for those who succeed us, as they gaze on the lineaments of these distinguished men, to have an opportunity of thus seeing what manner of men they were on whom we delighted to confer honour. In the name of the subscribers I beg to present this portrait to the Academy, and desire, in conclusion, to express the hope, which is shared in by all present, that Dr. Ingram may contiuue long amongst us and adorn the Academy of which he has so long been a distinguished member.

The Chairman said Lord Rosse had expressed his regret that he was not able to be present on this occasion, and therefore it fell to his lot as senior Vice-President, to take the chair when this presentation was being made. It was quite unnecessary for anyone

occupying the chair of the Academy on such an occasion to make any lengthened remarks on their ex-President, Dr. Ingram, and he was quite sure they would unanimously receive with pleasure the presentation of this portrait. He was glad to be reminded by Sir John Banks that he had the honour of proposing Dr. Ingram, originally, as a Member of the Academy. Personally, his relations with Dr. Ingram through life had been of the most intimate friendship and affection, and in asking their hearty acceptance of this portrait of their ex-President, he was quite sure that the Members of the Academy would join heartily with him in a warm and cordial acknowledgment of the services which he had rendered to the Academy. It afforded him the greatest possible gratification to ask them to accept by their applause the portrait now placed before them. It afforded him great pleasure to accept in their name the gift of this portrait of their ex-President, Dr. Ingram. He felt greatly struck and gratified with the success of the distinguished artist in executing the picture.

A collection of antiquities recently acquired for the Academy's Museum was exhibited; including an ecclesiastical ring of gold, a piece of gold "ring money," a number of bronze swords, rapiers, spear heads, fibulæ, pins, various stone objects, querns, celts, &c., flint arrow heads, mediæval ecclesiastical tiles, wooden "otter traps," and ancient beads.

TUESDAY, MARCH 16, 1897.

(STATED MEETING.)

RIGHT HON. THE EARL OF ROSSE, K.P., F.R.S., President, in the Chair.

The President declared the ballot open for the election of President and Council for the ensuing year; also for the election of Honorary Members, and appointed Mr. G. Coffey and Mr. F. W. Moore as scrutineers.

The Secretary of Council read the following :—

REPORT OF THE COUNCIL FOR THE YEAR 1896–97.

Since the date of the last Report the following Publications of the Academy have been issued :—

Transactions, vol. XXX.

Part 18. "On a Volcanic Neck, of Tertiary Age, in the county of Galway." By Professor Sollas, D.SC., F.R.S., and A. M'Henry, M.R.I.A.

Part 19. "On Scalar Invariants of two Linear Vector Functions." By Charles J. Joly, M.A., F.T.C.D.

Part. 20. "On Species of *Phoxocephalus* and *Apherusa*." By W. T. Calman, B.SC.

Transactions, vol. XXXI.

Part 1. "On Deep-Sea Crustacea from the South-west of Ireland." By W. T. Calman, B.SC.

Part 2. "Notes on the Prehistoric Cemetery of Loughcrew, with a Fasciculus of Photographic Illustrations of the Sepulchral Cairns." By George Coffey, B.E.

Proceedings.

Of the *Proceedings*, Third Series, Part 5 of Vol. III., was published in May, 1896, and contained the following Papers :—

"Prehistoric Settlements at Portnafeadog, in the Parish of Moyrus, Connemara." By Francis Joseph Bigger, M.R.I.A.

"Notes on the Composition of Ancient Irish Gold and Silver Ornaments." By Ernest A. Smith, Assoc. R.S.M., F.C.S.

"On a Double-Cist Grave and Remains recently discovered at Oldbridge, county Meath." By George Coffey, B.E.

"On Two New Species of Phycopeltis from New Zealand." By A. Vaughan Jennings, F.L.S., F.G.S.

"Note on the Rôle of Osmosis in Transpiration." By Henry H. Dixon, B.A.

"On Five Gold Fibulæ lately discovered in the South of Ireland, and on the Art Processes used in their Manufacture." By Dr. W. Frazer, and Mr. Edmond Johnson, M.R.I.A.

"The Paten of Gourdon, Illustrated from The Book of Armagh." By the Rev. T. Olden.

And Part 1 of Volume IV. in December, 1896, containing the following Papers :—

"Quaternion Invariants of Linear Vector Functions and Quaternion Determinants." By Charles J. Joly, M.A.

"Prehistoric Cenotaphs." By George Coffey, B.E.

"Report upon the Raised Beaches of the North-east of Ireland, with special reference to their Fauna." By R. Lloyd Praeger, B.E.

"Magh Adhair, County Clare. The Place of Inauguration of the Dalcassian Kings." By Thomas Johnson Westropp, B.A.

"On the Osmotic Pressure in the Cells of Leaves." By Henry H. Dixon, B.A.

"The Ethnography of Ballycroy, County Mayo." By Charles R. Browne, M.D.

"Additions to the Hepaticæ of the Hill of Howth, with a Table showing the Geographical Distribution of all the Species known to grow there." By David McArdle.

"A Study of the Languages of Torres Straits, with Vocabularies and Grammatical Notes." (Part II.) By Sidney H. Ray, and Alfred C. Haddon, M.A.

The following Publications are in the Press :—

Transactions, xxxi.

Part 3. "Report on the Expedition to Rockall." By Rev. W. S. Green, and others.

Part 4. "Further Development of the Relations between Impulsive Screws, and Instantaneous Screws, being the Eleventh Memoir on the Theory of Screws." By Sir Robert Ball, LL.D., F.R.S.

The following Science Grants, recommended by the Council, were sanctioned by the Academy :—

£40 to a Committee, consisting of Dr. R. F. Scharff, Dr. E. J. Mc Weeney, Professor T. Johnson, Messrs. R. Ll. Praeger, G. Pim, G. H. Carpenter, F. W. Moore, A. R. Nichols, G. E. H. Barrett-Hamilton, R. J. Ussher, and D. Mc Ardle to assist them in continuing their Researches into the Fauna and Flora of Ireland.

£25 to a Committee consisting of Rev. Dr. Haughton, Professor D. J. Cunningham, Professor A. C. Haddon, and Dr. C. R. Browne, to assist them in carrying on the work of the Anthropometrical Laboratory, and the Ethnographical Survey of the remote districts of Ireland.

£20 [as a supplemental Grant] to a Committee consisting of Mr. R. M. Barrington, Professor A. C. Haddon, Rev. W. S. Green, Mr. R. Ll. Praeger, and Professor E. P. Wright, to assist them in investigating the Zoology, Botany, and Geology of the Island of Rockall, and to dredge in its vicinity.

£10 to a Committee consisting of Messrs. W. J. Knowles, R. Ll. Praeger, W. H. Patterson, and F. J. Bigger, to assist them in investigating the Prehistoric remains in the neighbourhood of Roundstone, and on the sea-shore along Mannin and Ballyconneely Bays.

£5 to Professor G. F. Fitz Gerald, and Mr. E. Cullum, to assist them in carrying on a series of Magnetic Observations at Valentia.

The following Members have been elected since 16th March, 1896:—

William Alexander Craig.
Thomas George Hennis Green.
Edward John Gwynn, M.A., F.T.C.D.
Rev. John Hammond, D.D.
John Merrick Head, F.R.G.S.
Edmond Johnson.
Rev. Henry William Lett, M.A.
Rev. Daniel M'Crea.
Rev. Joseph M'Keefry.
Alexander Charles O'Sullivan, M.A., F.T.C.D.
Thomas Preston, M.A., F.R.U.I.
Right Hon. Christopher Talbot Redington, D.L.

At the Stated Meeting, on the 16th March, 1896—

William Ramsay, F.R.S.,
Rev. Thomas George Bonney, F.R.S.,
Sir William Flower, K.C.B., F.R.S.,

were elected Honorary Members in the Section of Science, and

The Right Hon. Lord Lister

(then Sir Joseph Lister, Bart.), President of the Royal Society, was proclaimed an Honorary Member under By-Law 14, Chapter II.

The Academy has lost by death within the year two Members:—

Rev. Denis Murphy, S.J., LL.D., elected 12th May, 1884.
General John Meredith Read, elected 14th January, 1867.

The Academy has also lost by death four Honorary Members in the Section of Science:—

Gabriel Auguste Daubrée, elected 16th March, 1869.
Emil Heinrich Dubois Reymond, elected 16th March, 1895.
Baron Ferdinand von Mueller, K.C.M.G., elected 16th March, 1894.
Karl Weierstrass, elected 16th March, 1895.

A statement of the facts relating to an anticipated contribution to the funds of the Academy, in aid of the progress of the Irish Dictionary, was laid before the Council in due course, but the Council report that, after full consideration of all the circumstances, there do not seem to be sufficient grounds to hope that the expected gift will be forthcoming.

The Council also regret that they have not yet been able to secure the co-operation of a competent scholar in the preparation of the Dictionary. The funds at command are so small, and the position being naturally of a temporary nature, and involving special qualifications, the number of persons from among whom a suitable assistant could be selected is limited, and does not permit a selection at will. But considerable progress has been made in the translation and study of Medical literature in Irish, which will in due time be laid before the Academy.

The fourth volume of the "Annals of Ulster," containing the Introduction and Index, has not yet been published, but the Editor, Rev. Dr. Mac Carthy, has been steadily at work upon it, and expects that the Index will be printed off before the end of the present Academic session, and the Introduction shortly after, so that the volume will, it is hoped, be published at the beginning of the autumn, thus completing the entire work.

The Rev. Edmond Hogan, S.J., Todd Professor, has resigned the Professorship, in consequence of other pressing duties rendering it impossible for him to devote to it the requisite time. The election of his successor will devolve upon the new Council at an early date.

The reproduction, by photolithography, of the "Yellow Book of Lecan," having been completed, the work was published during the past year, it being the fifth of the Academy's facsimiles of the more important Irish Manuscripts.

During the past year a large number of Antiquities have been acquired for the Museum. These include many bronze weapons and implements, swords, dagger-blades, celts, etc., and two exceptionally fine specimens of rapiers; also some fibulæ, rings, pins, and portions of bridle-bits, etc. The Academy has also acquired a collection of upwards of 700 flint objects, including flint knives, some very perfect specimens of a rare form of tanged knife-blades, and a representative collection of flint arrow-heads from the north of Ireland. This is the most important acquisition in this department which the Academy has made for some years. In addition to the foregoing, some fine specimens of querns, and over 200 other stone objects, have been obtained; also two excellent collections of beads, and 9 wooden objects, known as "otter traps."

Two additional rooms in the Museum Building will shortly be made available for the display of the Academy's collections. The western gallery of the large central court has been for some months occupied by Ogam inscribed stones and other large stone objects, which had been at first placed in the Crypt.

The Council regret to say that they have not yet had any communication from the Government as to the filling of the post of Curator of the Academy's Museum, which has remained vacant since November last.

Major Robert Mac Eniry was appointed Curator of the Academy's Museum in April, 1872. The entire collection was transferred to the New Science and Art Museum Building under an Agreement between the President and Council of the Royal Irish Academy, and the Lords of the Committee of Council on Education, of June, 1890, when Major Mac Eniry became a member of the Civil Service. The Council, at the time, understood that he would rank for pension as an ordinary Civil Servant from the date of his first appointment.

In November last he was retired by the Science and Art Department without any pension, though with the offer from the Treasury of one half-year's salary as a gratuity. The Council, remembering Major Mac Eniry's long and valuable services, petitioned the Treasury, through His Excellency the Lord Lieutenant, on this subject, but without effect.

The Report was adopted.

Donations to the Library were announced, and thanks were voted to the Donors.

On the Report of the Scrutineers, the President declared the following elected as President and Council for the ensuing year:—

PRESIDENT.

RIGHT HON. THE EARL OF ROSSE, K.P., LL.D., F.R.S.

COUNCIL.

Committee of Science.

Edward Perceval Wright, M.D.
Francis A. Tarleton, LL.D., D.SC.
Benjamin Williamson, D.SC., F.R.S.
Joseph P. O'Reilly, C.E.
George L. Cathcart, M.A.
George Henry Kinahan, C.E.
William J. Sollas, D.SC., F.R.S.
Robert F. Scharff, B.SC., PH.D.
Arthur A. Rambaut, M.A., D.SC.
Greenwood Pim, M.A.
Grenville A. J. Cole, F.G.S.

Committee of Polite Literature and Antiquities.

Robert Atkinson, LL.D.
Rev. Maxwell H. Close, M.A.
Sir John T. Gilbert, LL.D., F.S.A.
William Frazer, F.R.C.S.I.
Louis C. Purser, M.A., LITT.D.
Most Rev. Bishop Donnelly, D.D.
Lord Walter Fitz Gerald.
Rev. John Henry Bernard, D.D.
John Kells Ingram, LL.D.
John Ribton Garstin, M.A., F.S.A.

On the Report of the Scrutineers, the President declared the following elected as Honorary Members :—

A. Michel Lévy.
Albert Von Kölliker.

The President, under his hand and seal, nominated and appointed

The Most Rev. Bishop Donnelly, D.D.,
John Kells Ingram, LL.D.,
Benjamin Williamson, SC.D.,
Sir John Gilbert, LL.D.,

to be Vice-Presidents of the Academy for the year 1897–8.

A ballot was opened for the election of Officers. Dr. Browne and Mr. Coffey acted as Scrutineers. The following were declared elected :—

TREASURER—Rev. M. H. Close, M.A.
SECRETARY—Ed. Perceval Wright, M.D.
SECRETARY OF THE COUNCIL—Robert Atkinson, LL.D.
SECRETARY OF FOREIGN CORRESPONDENCE—Joseph P. O'Reilly, C.E.
LIBRARIAN—Sir John T. Gilbert, LL.D.
ASSISTANT SECRETARY—Robert Macalister, LL.B.

The Academy then adjourned.

MONDAY, APRIL 12, 1897.

SIR JOHN T. GILBERT, LL.D., a Vice-President, in the Chair.

George Bryers, Rev. Michael P. Hickey, and Edward Parnall Culverwell, M.A., F.T.C.D., were elected Members of the Academy.

Professor O'Reilly, C.E., read a Paper "On the constitution of the 'Calp' Shale of the neighbourhood of Dublin."

The Secretary read for Margaret Stokes, Hon. M.R.I.A., a Paper "On some typical examples of the High Crosses of Ireland."

Donations to the Library were announced, and thanks were voted to the Donors.

Read the following letters:—

"WÜRZBURG, the 20*th March*, 1897.

"To the Secretary of the Royal Irish Academy.

"SIR,

"Your Academy has done me the great honour to elect me as an Honorary Member in the Department of Science.

"I take the liberty to ask you to present to the Academy my warmest thanks for this election, and to add at the same time, that I I shall always be proud to range amongst the Members of your distinguished scientific Corporation.

"I am, dear sir,

"Your most obedient servant,

"PROF. ALBERT VON KÖLLIKER."

"PARIS, le 22 *Mars*, 1897.

"MONSIEUR,

"Vous avez bien voulu me faire part de ma nomination comme membre honoraire de la Royal Irish Academy, Section des Sciences.

"Je suis profondément flatté et honoré de cette marque d'estime

pour mes travaux et je vous prie de bien vouloir être, auprès de vos collègues, l'interprête de mes sentiments de profonde gratitude.

"Veuillez agréer, Monsieur, l'expression de mes sentiments de haute consideration et de dévouement.

"A. MICHEL LÉVY,

"*Membre de l'Institut.*"

MONDAY, APRIL 26, 1897.

PROF. J. P. O'REILLY, C.E., in the Chair.

Mr. Edmond Johnson and Mr. George Bryers signed the Roll, and were admitted Members of the Academy.

The Secretary read a Paper by Mr. R. J. Ussher, "On a discovery of Human and other Remains, with materials similar to those of a Crannog, high above the present valley of the Blackwater, between Lismore Castle and Cathedral."

Dr. C. R. Browne read a Paper by himself and Prof. Cunningham, "On some Human Remains lately discovered in Lismore by Mr. Ussher."

The Secretary read for Mr. Ralph Cusack the following Papers:—(1) "On Human Locomotion—Variety of Velocity when walking"; (2) "On the effect of change in temperature on Phosphorescent Substances."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, MAY 10, 1897.

SIR JOHN GILBERT, LL.D., a Vice-President, in the Chair.

Edwin William Lovegrove, M.A., was elected a Member of the Academy.

Donations to the Library were announced, and thanks were voted to the Donors.

The Treasurer laid on the table the Accounts for 1896–7 as audited; also the Estimate of Income and Expenditure for 1897–8.

MONDAY, MAY 24, 1897.

SIR JOHN GILBERT, LL.D., a Vice-President, in the Chair.

Mr. Thomas Preston, M.A., signed the Roll and was admitted a Member of the Academy.

Mr. T. J. Westropp, M.A., read a Paper on "The distribution of Cromlechs in the County of Clare."

Dr. Frazer exhibited a Silver Cup lent for Exhibition by Mr. Waterhouse.

Mr. Coffey exhibited a Spear found near Enniskillen by Mr. Thomas Plunkett, M.R.I.A.

The following Science Grants, recommended by the Council, were sanctioned by the Academy:—

£100 to a Committee consisting of Lord Rosse, Dr. G. F. Fitz Gerald, and Mr. E. Cullum, to assist them in carrying on the Magnetical Observatory at Valentia.

£35 to a Committee consisting of Rev. Dr. S. Haughton, Dr. D. J. Cunninghan, Dr. A. C. Haddon, and Dr. Charles R. Browne, to assist them in carrying on the work of the Anthropometrical Laboratory, Trinity College, Dublin, and the Ethnographical Survey of Ireland.

£12 to Mr. Henry Dixon, to assist him in carrying on his investigations of the Physics of the Transpiration Current, and the Problem of the Ascent of Sap in High Trees.

£6 to a Committee consisting of Dr. E. P. Wright, Messrs. F. W. Moore, and D. M'Ardle, to assist them in the investigation of the Irish Hepaticæ.

£35 to a Committee consisting of Dr. R. F. Scharff, Messrs. G. H. Carpenter, A. R. Nichols, G. E. H. Barrett-Hamilton, R. J. Ussher, R. Lloyd Praeger, and H. Lyster Jameson, to assist them in continuing their researches into the Fauna of Ireland.

£12 to Mr. Thomas Plunkett to assist him in exploring a large Cairn a short distance from Enniskillen.

The Treasurer, in accordance with By-law 3, Chapter III., read a List of Members in arrear.

Donations to the Library were announced and thanks were voted to the Donors.

MONDAY, JUNE 14, 1897.

MOST REV. DR. DONNELLY, LORD BISHOP OF CANEA, a Vice-President, in the Chair.

Thomas Frederick Cooke Trench, D.L., was elected a Member of the Academy.

Sir John Gilbert, LL.D., read a Paper, "Notes on Irish Bibliography—Notices on Publications by Irish Authors, or in connexion with Ireland, printed in the 17th Century."

Dr. C. R. Browne read a Report by himself, Mr. G. Coffey and Mr. T. J. Westropp, "On a prehistoric burial near Newcastle, county Wicklow."

Dr. Frazer exhibited a silver chalice from Carrickmacross Church, by permission of Rev. B. W. Moffett.

Donations to the Librarv were announced, and thanks were voted to the Donors.

On the motion of Mr. John Ribton Garstin, D.L., seconded by Mr. F. Elrington Ball, it was resolved:—"That an address of Congratulation to Her Majesty the Queen, Patron of the Academy, on the completion of the Sixtieth Year of Her Reign, be drawn up by the Officers of this Academy for adoption by the Academy."

The following draft was accordingly submitted:—

To HER MOST GRACIOUS MAJESTY QUEEN VICTORIA.

MAY IT PLEASE YOUR MAJESTY,

WE, the President and Members of the Royal Irish Academy, beg to offer to Your Majesty our most Loyal and Hearty Congratulations on the completion of the Sixtieth Year of Your Reign.

Since His Majesty George III. founded our Academy in 1786, each Reigning Sovereign of Great Britain and Ireland has been our Patron.

Established in the Kingdom of Ireland for the study of Science, Polite Literature, and Antiquities, we and our predecessors have

now, for over a Century, devoted ourselves to this task, and we are gratified to know that the published Records of our Labours are in Your Majesty's Library at Windsor.

We tender to Your Majesty the assurance of our Loyal Devotion, and we pray that You may be long spared to occupy the Throne of these Realms.

Signed on behalf of the Royal Irish Academy,

Rosse, *President*.

E. Perceval Wright, M.D., *Secretary*.

Academy House,
Dawson Street, Dublin,
June 14th, 1897.

On the motion of Master Pigot, seconded by Dr. Frazer, it was resolved:—"That the Address to Her Majesty the Queen, just read, be adopted, and that the President and Secretary of the Academy (accompanied by the Mace) do present the same, on behalf of the Academy, at whatever time and place shall be appointed."

Monday, June 28, 1897.

Sir John Gilbert, ll.d., a Vice-President, in the Chair.

The Very Rev. Hugh O'Reilly signed the Roll, and was admitted a Member of the Academy.

John Joly, sc.d., f.r.s., was elected a Member of the Academy.

Mr. C. J. Joly, m.a., f.t.c.d., read a Paper "On the Associative Algebra applicable to Hyper-Space."

Dr. C. R. Browne read a "Report on the Ethnography of Clare Island and Innishturk, Co. Mayo."

Mr. G. Coffey, a.i.b., read a "Note on a recently discovered 'Ship-marking' at Dowth."

Donations to the Museum and Library were announced, and thanks were voted to the Donors.

Read letter from the Secretaries of the International Congress of Orientalists, inviting the Academy to be represented by a Delegate.

It was resolved :—

"That the invitation of the International Congress of Orientalists to attend the meeting to be held in Paris between the 5th and 12th of September, be accepted, and that Professor R. Atkinson, LL.D., be appointed as the Academy's Delegate, and that this appointment be made under the Seal of the Academy."

MONDAY, NOVEMBER 8, 1897.

DR. J. K. INGRAM, S.F.T.C.D., a Vice-President, in the Chair.

Mr. Thomas Frederick Cooke-Trench, D.L., signed the Roll, and was admitted a Member of the Academy.

The Secretary read a letter from the President (The Earl of Rosse, K.P.), stating that he, accompanied by Lord Powerscourt and Mr. John Ribton Garstin, had presented to H.R.H. the Prince of Wales, on behalf of the Queen, the Academy's Address to Her Majesty on the completion of the sixtieth year of Her reign, and that His Royal Highness had handed him the following reply :—

"On behalf of the Queen, my dear mother, I thank you for your loyal and dutiful Address, and for the affectionate congratulations which you tender on the completion of the 60th year of Her reign.

"It is a source of profound joy to the Queen to receive the expressions of devotion to Her Person and Family, which are offered by Her subjects throughout the Empire; she is gladdened by the thought that the sixty years of Her reign have been years of progress in knowledge and of increase in prosperity; and she prays that, by the blessing of Almighty GOD, she may always live in the hearts of Her loving and beloved people."

The death of the Rev. Dr. Haughton was announced, whereupon Dr. F. A. Tarleton, F.T.C.D., moved, and the Earl of Belmore, G.C.M.G., seconded:—

"That the Academy hereby places on record its deep sense of the great loss which it and Science have sustained by the death on the 31st of October last, of the Rev. Samuel Haughton, M.D., LL.D., D.C.L.

"Elected a Member of the Academy fifty-three years ago, Dr. Haughton was, in 1848, awarded a Cunningham Medal for a Memoir 'On the Equilibrium and Motion of solid and fluid Bodies.'

"He served for over thirty years on the Council, and was elected President in 1886.

"The Academy tenders to the Members of his family its sincerest sympathy in their bereavement."

It was resolved that, "Sir Robert Ball's Paper 'On the Theory of Screws,' be taken as read, and that the Academy as a mark of respect to the memory of the late Rev. Dr. Haughton, do now adjourn."

TUESDAY, NOVEMBER 30, 1897.

(STATED MEETING.)

RT. HON. THE EARL OF ROSSE, K.P., F.R.S., President, in the Chair.

The Secretary read a letter from Sir William Kaye expressing the regret of His Excellency the Lord Lieutenant that, in consequence of urgent official business, he found himself unable to be present at the Meeting.

Rev. J. E. H. Murphy, M.A., Rev. S. Hemphill, D.D., and Rev. J. P. Mahaffy, D.D., F.T.C.D., signed the Roll, and were admitted Members of the Academy.

The President then delivered his Address:—

In accordance with the custom which prevails in the Royal Irish Academy, that the President should at some time during his term of office deliver an Address, I have put together a few observations which seem to be appropriate to the present occasion.

This year may, I think, be considered to have been an eventful one for the Academy; not because of its being the sixtieth year of Her Majesty's reign, in which they felt it to be their duty, in common with other Bodies of Her subjects, to adopt an address of congratulation, which I, in conjunction with Mr. Garstin and Lord Powerscourt, presented to the Prince of Wales, on behalf of the Queen, but rather because the Academy's rich collection of Irish Antiquities has passed under the care of a new keeper, after too long an interval since the retirement of Major M'Eniry, who had grown old in the service and had for some time past been indisposed.

It is to be hoped that the arrears of work, which are by this time very large, will now be gradually overtaken, and that in the future the collection, properly accommodated, may be put into such a condition for the instruction of those who have made archæology their special study, and for examination by the general public, as its importance demands. It is to be hoped, also, that there will always be an adequate staff for the proper arrangement and classification of such objects as are continually coming to hand for addition to the collection. This collection, being unique and of great interest not only to persons from various parts of Ireland, but also to visitors to Dublin, and to Celtic scholars from various parts of the world, deserves to have full justice done to it in the National Museum.

It is satisfactory to find that the field for work on Irish Antiquities is by no means exhausted, and that there is still a hope of unveiling some of the mysteries in which the remote periods of ancient Irish history are involved, and into which many of us much desire to penetrate.

In the late president's address, in 1892, I notice the statement that "only sixteen out of seventy-six ronnd towers were illustrated by Lord Dunraven, and about twenty out of a very large number of sculptured crosses by O'Neill. Though much progress may have since been made, yet here there may still be an abundant field for the industrious photographer. Should not all these structures as well as those ancient Irish churches and buildings which have not been properly photographed be taken and printed by some "permanent" process?

Last summer a movement was started in London by Sir Benjamin Stone, M.P. for East Birmingham, an enthusiastic photographer, in

this direction, and an association was formed under the name of the "National Photographic Record Association." It is proposed that "permanent" prints of all objects of interest, especially those which are likely to be swept away by the advance of our manufacturing and commercial civilization—if I may use the expression—shall be stored up in some suitable place. I attended the first meeting, when the association was duly formed, as the representative of an English body, but I was informed that it was not proposed to limit the movement to England, and I was asked to consider myself as representing Ireland, and particularly this Academy. Though we are not likely to be affected in the same way by the results of a large increase of population and of commercial activity, still there may be cases where the "permanent" paper print may survive the object which it portrays. If papyri survive, and can be more or less read after having been in a position of neglect for 2000 years, should not these photographs be equally enduring in proper and safe keeping? The Royal Society of Antiquaries of Ireland have already made a considerable collection of permanent photographs of our Irish antiquities which it strikes me is not as well known as it deserves.

There is reason to believe that, notwithstanding all efforts to make known the readiness to receive articles of antiquarian interest for the Academy Museum, and to give full value for anything of interest which may be found, this information fails to reach all those who may be fortunate in their finds, and I think that we should seek to spread more widely the laws and regulations about Treasure Trove.

I would also wish that there were more of the true spirit of patriotism among our collectors; for then the last wondrous find of gold ornaments in the north of Ireland would probably have added to the glories of our collection, and not have found its resting-place among the riches of the Antiquarian Department of our British Museum.

While in the department of Irish antiquities the Royal Irish Academy holds a field which it can well call its own, in science more cosmopolitan considerations much affect it. Science is now widely diffused, and the workers in every line are so numerous, that naturally the earliest opportunity is taken to put before the world all new facts and discoveries. There is a hot rivalry in pushing forward each step between individuals, institutions, communities, and countries; also the

accumulations of communications is so great that many are easily overlooked, and the periodicals which have the widest circulation and possess the highest standard of reputation are often selected in preference to the publications of a local society.

Still, notwithstanding the facilities for travelling to a great scientific centre, and the rapid communication through the post, which yearly becomes more marked, there is yet room for much profitable work and discussion on the spot, and the free and rapid interchange of ideas face to face and in a university town, in the metropolis of this island, where there is much literary and scientific activity seems likely long to hold its own as an effective means for the advancement of knowledge.

One of the difficulties under which a scientific society labours is the want of a *continuous* supply of communications of adequate interest for reading and discussion at its meetings. If there be too much to get through within the time available at one meeting there will be too little at others, and the temptation is strong to send in work rather to supply the deficiency and to fill up the hour or hour and a half than because, in the opinion of the author and others a communication is of sufficient interest to bring forward.

It occurs to me that the desired material might often be supplied, as has been done elsewhere, by verbal communications of recent work which has been already published, which can be afterwards discussed by those present, and further information asked from the communicator as desired.

From the recently published "Record of the Royal Society of London," it appears that in the early days of that distinguished body "Papers were read then, as now; but the reading of Papers formed only a part and by no means a great part of the business of the meeting. Much time was spent in discussing the bearings of such experiments as were shown, and in devising other experiments to be shown at some subsequent meeting, or in instituting investigations to be carried out in divers places and under various circumstances."

Now whatever this may mean, there can be little doubt that many things must have been gone into which were not entirely new, which, though very recent, may have seen the light before. These meetings seem to have been something intermediate between those intended solely for the reading of original Papers and the formal lecture,

generally partaking more or less of a popular character as intended for a larger and more mixed audience, such as that at the Friday evenings of the Royal Institution in London or the afternoon lectures of the Royal Dublin Society.

At the evening meetings of the Royal Dublin Society in recent years, abstracts of Papers in current periodicals have sometimes been given and experiments shown, I think, with advantage, and have, I believe, given increased interest to the meetings.

I commend these facts to the consideration of the Royal Irish Academy.

Probably no body has suffered more from competition than the British Association for the Advancement of Science, which meets only *once* a year. People cannot wait so long for the bringing out of their results. But the loss of original work has, I think, been in great measure compensated for by bringing forward again communications, already published, for discussion before a larger audience in one of the sections, or even before the united audiences of two sections.

Perhaps it may not be out of place for me to interpose here a few remarks on the position of various archæological, literary, and scientific societies in Ireland.

One cannot but feel that with our small population relatively to that of other places, and the greater part of that small population of that class which, engaged in agricultural pursuits, far removed from contact with literary or scientific circles, and taking little interest in the advance of knowledge outside of its own immediate requirements, we may very easily spread our efforts among too many societies and too many small meetings. It is one thing to classify our work, so that Papers in each line, or in cognate lines of research, may be collected together for reading before, and discussion by, an audience specially competent to discuss those subjects. It is another to include Papers dealing with a wide range of questions, and read them before a very mixed scientific audience, few of those present being qualified to discuss each effectively.

You are aware that there are other antiquarian Societies in Ireland working in their respective spheres and localities, but the Academy is on friendly terms with them, and gives them all the assistance in its power, and they are probably able to cover ground in their respective neighbourhoods in a way that the Academy is not

so well able to do. It may, however be open to question whether some of the work might not be more effectually done by greater concentration of effort.

I leave this matter to those members who have specially pursued their studies in this direction, and pass on to the scientific side.

It so happens that I am in the unique position of having been elected in turn to the office of President of each of the two leading scientific Societies in Ireland. Very many are members of both the Royal Irish Academy and the Royal Dublin Society, and are therefore in a good position to look upon both sides of a question which has become more or less of a controversy, from the necessity of authors selecting one or the other body before which to read their communications. But as President I have had the matter thrust more prominently before me on both sides and in all its bearings.

One cannot but be struck by the fact that, in so small a community as Dublin—for persons living in the country share very little in the work of its scientific Societies—there should be two institutions overlapping so much of one another's field of work.

The Royal Dublin Society, established as it was more for the applications of science to the Arts and Industries, has more concern with, and is more widely known by its connexion with, what is now and is ever likely to be in the future by far the largest industry in Ireland—I mean that of Agriculture. Still it has its scientific side, the popular or lecture department and the sections for the reading and discussion of Papers, for demonstrations of an informal character and abstracts of recent Papers. These communications are in some cases of a practical character, on the application of scientific principles to practical and commercial questions; but others are on matters of abstract science, and so cover some of the ground which is embraced by the Academy.

On the side of the Academy it is said that *here* is the proper and legitimate place for the discussion of abstract and theoretical questions. On the side of the Dublin Society, attention is drawn to the fact that they have had in the past and at least equally so in their present Lecture Theatre facilities for illustration and experiment which *we* do not yet possess; also that the interest of a considerable sum of money is available to defray the cost of the publication of such of the papers read at their meetings as may be suitable. The

appliances, however, needed for illustrations can, most of them, be easily supplied. In these days most societies have their lime-light lantern, and even an electric lantern can be worked with facility from a town supply, and a gas supply for chemical and physical experiments can easily be brought to the table.

However, it seems likely that the two Societies will still co-exist as scientific institutions. It is not always easy to set right the errors and oversights of our forefathers; but cannot there be some more concert in their efforts with a view to more effective work?

It appears to me that more might be done in this Academy to keep the antiquarian and the scientific side distinct. Two *separate* series are now in some cases brought out; but could not more be done to have antiquarian evenings and scientific evenings, though the convenience of authors might still be carefully consulted. In a society where a large range of subjects is treated of, there cannot be a *general* interest. Where Physics and Physiology may be discussed, the physicists or the physiologists, as the case may be, are unable to follow, fall asleep, or go away; and the case may be even stronger where so distinct matters as Antiquities and Natural Science are intermingled, though, nevertheless, here there appears generally to be a fair attendance.

Again, a country member recently drew attention to the inconvenience arising from the meetings of the Academy and the Dublin Society being on different days. He would like to attend the Academy in the afternoon and the Dublin Society in the evening. As a country member I have much sympathy with his view.

Having been on the Council of the Academy for several years, I would beg leave further to remark on the inconvenience of the meetings of Council and of the Academy taking place on different days. In the Physical Society of London the Council and the Society meet once a fortnight on the *same* day; and the Astronomical Society has its monthly councils and general meetings on the same day, and its country members take a large part in its proceedings.

On the Antiquarian side, it may be worthy of remark that the preparation for the press of the "Annals of Ulster," entrusted to the Academy by the Government, who also provide funds for the purpose, is making satisfactory progress, though slower than had been anticipated. The Academy will be further glad to know that Miss Stokes

is engaged upon an interesting work on Irish High Crosses, which is intended for a monograph to be published by the Academy. It is probable, however, that some time will elapse before it will be ready.

In the department of Science we may notice the second expedition to Rockall, the cost of which was partly defrayed from the funds at the disposal of the Academy, and which was organized and taken part in by some of its members. They had a vessel placed at their disposal by the Government for the purpose. It is to be regretted that, though the expedition succeeded in collecting a good deal of information relative to the island, the state of the weather did not allow them to effect a landing during the several days that the vessel lay off it. The chances of this being possible on a future occasion do not seem very great.

Early in this year my attention was called to a probability that the Magnetical Observatory at Valentia, or rather Caherciveen, might have to be closed. The Academy has at various times voted sums towards this Observatory: the temporary building was erected by them, but the instruments were lent for a time by Trinity College, and the observations have been made gratis by the Observer of the Meteorological Council. This arrangement obviously lacks the permanent character which the importance of the geographical situation should command. With the view of placing the Observatory on a more permanent footing, it is proposed to purchase instruments to replace those now on loan—£100 to £120 will be required for this—and to raise such a sum as will furnish £25 per annum as a salary for the Observer. It is only the fortunate circumstance of there being on the spot a meteorological establishment under an intelligent and competent head that renders such a scheme possible for so moderate an outlay. One would think that the capital sum required to provide a permanent endowment of £25 per annum—say £900—should be easily raised in Ireland: that Ireland might say, Let us do our share of the world's work in terrestrial magnetism, by keeping so commanding a station as that of the Valentia Observatory in an efficient state. Though contributions come in but slowly, I feel confident that somehow or other the required funds will be found.[1] The Academy, as a body, has already recog-

[1] Subscriptions will be gladly received by Professor Fitz Gerald, F.R.S., or myself, towards this object.

nized the importance of the object by a substantial vote towards it. From Dublin, in the past, I may remind you, important contributions to our knowledge of the subject have come through the labours of the late Provost Humphrey Lloyd, a former President of the Academy, who established the Observatory in the Fellows' Garden of Trinity College, in which work was carried on until its continuance appears to have been considered scarcely necessary. The Dublin Station is obviously far inferior in importance to that at Valentia. In vol. I, p. 221, of the third series of our Proceedings will be found a short account of the present temporary observatory, and of the instruments at present in it, by Professor Fitz Gerald of Trinity College.

Although notice has already been taken by the Academy of the recent death of one of its former presidents, the late Dr. Haughton, I cannot refrain from some allusion to the great loss which we have sustained by his death. Having begun life with a most distinguished university career, followed by the unusual, if not unprecedented, feat of obtaining a Fellowship in Trinity College only a few months after his Bachelor's degree; he continued to work hard all his life at an extended and extending range of subjects. He was a frequent contributor to the publications of the Academy and to other Journals. He formed, perhaps, the only remaining link with the past, when M'Cullagh, Robinson, Lloyd, and others contributed so much to the work and life of what has been looked on as a brilliant era of the Academy. His Papers in all were very numerous (the number of entries in the Royal Society Catalogue of scientific papers, from 1846 to 1882, is 173), and he worked on steadily almost to the end. As Professor of Geology in Trinity College he had his thoughts particularly directed to that subject, and his Geological Papers are very numerous. He also wrote on the theory of the tides, the crust of the Earth, the wave theory of light, and animal mechanics. In 1862 he took out the degree of M.D. in Trinity College, and was appointed Registrar of the Medical School. He devoted his usual energy to the reorganization of the School, and during the visitation of cholera about that time was active in promoting reforms in the Dublin hospitals. He wrote also for a time on medical subjects in various publications. He brought out, as you know, a Manual of Geology, also some other educational works in conjunction with the late Professor Galbraith. He received the honorary degrees of D.C.L. from Oxford,

LL.D. from Cambridge, LL.D. from Edinburgh, and M.D. from Bologna. He was for twenty years Secretary of the Zoological Society of Ireland, and did much by his energy and tact to bring the Society into its present state of comparative prosperity. He had been a member of this Academy since 1845, had been on the Council for many years, and was President from 1886 to 1891. He received the Cunningham Medal for his Memoir on the "Equilibrium and Motion of Solid and Fluid Bodies." He was elected a Fellow of the Royal Society of London in 1858. His energy appears to have remained with him almost to the last, and quite recently on our Council, he took an active interest in the proceedings. He was looked on by all who had the advantage of his acquaintance as a most pleasant and genial friend.

One cannot but be struck with the wide range of the branches of Science treated of in our Proceedings and Transactions, embracing nearly all branches of Natural knowledge, and it would be out of place here to give more than a cursory glance at them. In fact, the recent numbers include Astronomy, Chemistry and Molecular Physics, Geology, Paleontology, Mathematics, Physics, Physiology and Biology. Still the total amount of matter, though as much as might be expected under the circumstances, is comparatively small.

In Astronomy we are much hampered by our climate. In common, more or less, with observers in other parts of the British Isles, we are often disheartened by the cloudiness of the sky, and, above all, by the uncertainty of the weather, so that effective work is altogether incompatible with any other fixed occupation. We have not the immense extent of country and variety of climate, nor the far greater range of elevation possessed by our friends on the continent of America, where, through the expenditure of large sums of money upon instruments superior to anything of their kind hitherto existing, and specially suited for the purpose, the two satellites of Mars and the fifth of Jupiter have been for the first time detected; but the quality of recent photographic work on astronomical objects from European observatories—from England, France, and Germany—in recent years, shows that there is still room for successful rivalry in the Old World.

In recent years the Academy has, I think, done its part in bringing out astronomical work. I might particularise Dr. Dreyer's

supplementary catalogue of Nebulæ, and the catalogue of Red Stars, edited by Mr. Espin, and the work of Mr. Birmingham, of Tuam, who suddenly came from his retirement in the co. Galway, and became celebrated as the discoverer of the variable star, *T. coronæ*, which was the first object of the kind that was brought under the examination of the spectroscope. Both these Papers appear, for the present, to cover all that is worth recording in their respective subjects.

I should not omit to make mention here of the International conference on a catalogue of scientific literature, which by means of index slips of all scientific papers, is preparing the way for a great international catalogue of scientific work. The conference was held last year in the rooms of the Royal Society of London. A London committee has been appointed, and your secretary, Dr. Wright, and Dr. Tarleton, F.T.C.D., have been asked to represent Ireland upon it.

In Chemistry and Physics we are at a disadvantage as compared with English Societies. We have not with us the manufacturer, ever looking to the theoretical worker for the improvement of the processes employed in his works, and the theoretical worker on the other hand stimulated in his researches by the prospect of combining profit from patents and from practical advice to the manufacturer, with the steady acquirement of "Natural knowledge" in the comprehensive words of the title of the Royal Society of London. The progressive manufacturer is often in a position to give important aid to philosophical inquiry.

But in the presence of large Medical Schools in Dublin, the place to which more than four millions of people look for relief from the ills to which flesh is heir, when local assistance has failed, we should have a very considerable stimulus to philosophic inquiry. Physics, Chemistry, and Physiology go hand in hand with medical practice, and perhaps the most striking examples in modern times which may be cited, of the assistance which philosophic inquiry has given to practical medicine, are, first, the steady work of many physicists on the electric discharge in vacuo, especially of Sir William Crookes, their labours seeming to show nothing beyond a purely scientific interest, until a foreign worker, Professor Röntgen, put the last small stone in the edifice, and brought to light the possibility, even the great probability, on the electric discharge in

vacuo becoming one of the daily implements of the surgeon. And to go just a little further back, have not the labours on another and essential part of the apparatus, the induction coil, the work of Ruhmkorff, Ladd, Apps, and many others, or we might even go so far back as that distinguished countryman of ours, the late Dr. Callan, of Maynooth College, which have gradually vastly improved that instrument, contributed to this result; and are we not aided much by the labours of Planté and others, who have transformed an interesting instrument, the secondary cell, into a practical commercial instrument ready at a moment's notice to provide the needed electrical energy?

Again, have not the theoretical labours of physiologists opened up a new method of treatment which has been called preventive medicine? For many years their philosophic labours had been pursued, and no practical result was apparent until Pasteur showed in a way which seems to have convinced all leading physiologists that these inquiries admitted of practical applications. Philosophical inquiry and applied science go hand in hand, and feel that they may be working one for the other.

The Oxford University Observatory was largely assisted in its foundation by the late Mr. De la Rue, who devoted much of his leisure in the intervals of business to the cause of science.

The late Mr. Gassiott, also a busy man in the commercial world, on the discontinuance of the annual grant from the British Association, came forward and permanently endowed the magnetical work of Kew Observatory, and, more recently, the Davy-Faraday research laboratory has been founded and attached to the Royal Institution, being housed, furnished, and equipped for work through the munificence of a gentleman (Dr. Mond) who was in a position to do so through the successful application of the principles of chemistry to a chemical manufacture. Such instances might be multiplied; but in most parts of Ireland we have one art and industry only—that of agriculture. Will it always be so? May we not look for some measure of success from the efforts of those who are doing their best to find some means for establishing Arts and Industries in Ireland? Progress in such a direction must necessarily be slow; but should some of the manufacturing life and energy which exists in many districts of England, and in a measure in some parts of Ulster, spread to other parts of this island, may we not look forward to the retention at home of some

of that energy, which, not taking to agriculture, now finds more congenial spheres of work in other parts of the world, and to this energy reacting and giving fresh life to our scientific societies.

May we not look forward to the more extended use of the National Museum of Art well arranged and classified as an aid in a revived art industry.

In conclusion, let me thank you for the honour which you have done me in electing me to the distinguished position of President of your Academy. I feel that I must ascribe it rather to the fact that it is my earnest desire, by the promotion of science, to contribute to the progress in prosperity and happiness and varied interests of the people of this island, than from any sufficient claims to have contributed substantially to that progress, that I have received that mark of your favour. I only regret that the distance of my home from Dublin and other circumstances beyond my own control have prevented me from giving that attendance at your meetings which may be reasonably expected of the holder of the office.

A vote of thanks to the President for his Address was moved by the Rev. Dr. Mahaffy, seconded by Judge Kane, and carried by acclamation.

Read the following letter:—

"12, Northbrook-road, *November* 15, 1897.

"To the Secretary,

"Royal Irish Academy,

"Dear Friend,

"We desire you to convey to the President and Members of the Royal Irish Academy our sincere gratitude for their warm appreciation of the value of the Rev. Dr. Haughton's life-work in the Academy, and their grief for his loss expressed in their Resolution of the 8th instant.

"The kind sympathy expressed towards ourselves has touched us very deeply, for well we know how he prized his companions there, and how true was his love for the Royal Irish Academy.

"It was there he received his earliest Honor, and there in his

later years was elected its genial President, and though a lifetime stretched between, it was one of earnest effort and faithful attachment to his beloved Academy.

"Yours in grateful remembrance,

"Isabel Haughton,
"William S. Haughton."

Donations to the Library were announced, and thanks were voted to the Donors.

Monday, December 13, 1897.

Most Rev. Dr. Donnelly, Lord Bishop of Canea, a Vice-President, in the Chair.

Rev. Michael P. Hickey signed the Roll and was admitted a Member of the Academy.

Rev. T. Olden, M.A., read "Some Notes Supplementary to Dr. Joyce's Paper 'On the occurrence of the Number Two in Irish Proper Names.'"

Rev. Dr. Mahaffy, F.T.C.D., read a Paper "On Papyri, recently discovered in the Ashmolean Museum, Oxford."

The Secretary read for Mr. H. T. Knox, "Notes on the Chronology of St. Patrick."

On the motion of Sir John Gilbert, LL.D., seconded by Ven. A. Tait, D.D., LL.D., Dr. Frazer was elected a Representative of the Academy on the Board of Visitors of the Science and Art Museum, &c., Dublin, in the room of the late Rev. Samuel Haughton, M.D., S.F.T.C.D.

Monday, January 10, 1898.

Dr. J. K. Ingram, S.F.T.C.D., a Vice-President, in the Chair.

Mr. Edwin Lovegrove, M.A., and Professor J. Joly, M.A., F.R.S., signed the Roll, and were admitted Members of the Academy.

The Rev. Thomas Mills, M.A., was elected a Member of the Academy.

Dr. H. H. Dixon read a Paper on "Effects of various Gases on Transpiration of Plants," and on "Transpiration into a Saturated Atmosphere."

Mr. F. W. Moore read a Report by Mr. D. M'Ardle, "On the Musci and Hepaticae of the County Cavan."

Dr. E. Perceval Wright exhibited some specimens of a Cyclamen from Tunis, and a map showing the distribution of the known species of the genus, and read the following note:—

On the 18th April, 1895, Mr. G. Cathcart and I found ourselves at Constantine, having journeyed eastwards from Oran. We were a day's journey from Tunis, two days' from Algiers; there was a choice of a steamer from either port to Marseilles; we determined to take the one from Tunis.

Spending a day at Hammam Meskoutine, to see the Boiling Springs and the Calcareous Cascades, we left it on the morning of the 19th April for Tunis. The railway crosses over a spur of the Atlas Range, the Mountains of Medjerdah, and then descends to sea-level at the town of Tunis. A great portion of this mountain is forest, and little is known about its flora. The steamer was not to leave the port until the 22nd. The 20th was devoted to a visit to Carthage; it was a showery, blustery day, cold for the time of year, but earlier the spring had been fine, and the first spring flowers were over. I had been at Tunis in January, 1870, and the difference between the aspect of the country around the lake as then and now was very great. In 1870 the Port was some seven miles from the town; the route thereto was a mere track along the margin of the lake; immense flocks of birds, the most conspicuous of which were flamingoes, quite thronged the sea margin; now the new canal, cut through the lake, enabled the steamers to come almost to the walls of the city. The birds, moreover, have deserted the place, and during the whole day I saw only a few plover and dotterel. Though there is a railway to Marsa, with a station at Carthage, we went by the new and excellent road. This road runs near the margin of the lake, bordered by land in cultivation, being for some miles but little above sea level. It is swampy, and immense patches of that strange wandering plant, *Cotula coronopifolius*, were growing most luxuriously, seemingly preferring brackish water, and were well in fruit. The day following was bright and warm; we took the train to Hammam el Enf, a village on the Gulf of

Tunis, with a north-east aspect. It is situated at the foot of Djebel Bou Kournein, a hill rising from the sea, and attaining a height of 589 metres. Its slope promised to give a good notion of the plants of the district, while a fine view of the surrounding country could be had from the summit. A mule-path was found mounting by many a zig-zag from the village to the top; the slopes were not very steep; and the greater portion was covered with herbage. The ground was in many places deeply scored by water courses, the result of heavy rains, which left large blocks of stone exposed. The most striking plants were shrubs of *Pistacia lentiscus*, *Cistus incanus*, *Myrtus communis*, *Erica arborea*, *Jasminum fruticans*, *Rosa canina*, while *Melilotus Indica*, *Psoralea bituminosa*—this latter quite a handsome plant—were intermingled. Carpeting the surface between all these were *Thymus capitatus*, *Hedysarum Spinosissima* and *Tordylium apulium*, the two latter very striking from their fine fruits. About the summit of the first knoll, colonies of *Cynomorium coccineum* gave a pink tinge to the ground.

But the most remarkable find was about half way towards the summit, where some lovely plants of *Cyclaminus Persica* Mill (*C. latifolium* Sibth. & Sm., *C. Punicum* Doum.), were found growing in shady nooks. The flowers were pink, with a darker zone at the throat of the corolla. Some were almost pure white; the leaves were as fresh as the flowers. The first specimen trowelled up showed the flower stalks straight, not rolled, and there could be no doubt that the specimens were those of the Persian Cyclamen. The flowers were delicately perfumed. I do not think that it would be possible to confound this species with *Cy. Africana* Boiss., which I had collected when in Algiers in 1870. This latter is an autumn flowering form (October–January), the flowers appearing before the leaves. Thinking that I had found an addition to the flora of North Africa, I took some specimens for the Trinity College Herbarium; but on my return I found the record of *Cy. Punicum* Pomel (Bull. Soc. Bot. Fr. 1889, p. 354), which by Battandier ("Flore de l'Algérie," 1890, p. 720) was placed as a synonym of *Cy. latifolium* Sibth. & Sm., and *Cy. Persicum* Hort, from "Frontière tunisienne." The description left no doubt but this was the plant I had found. No specimen, however, is to be found in Cosson's Herbarium, from Tunis, so his record must remain uncertain. When going over the species of Cyclamen

in the British Museum last October, Mr. E. G. Baker called my attention to the "Catalogue raisonné des plantes vasculaires de la Tunisie," par Ed. Bonnet et G. Barratte. Paris: Imp. Nationale, 1896, which had quite recently come to hand. Here *Cy. Persica* is recorded not only from Dj. Bou-Kournein, but from other localities near Tunis. Many interesting details about this species and its geographical distribution are also given, and the reasons assigned for adhering to the specific name of Persica, and for adopting the generic form of Cyclaminus, appear unanswerable.

The following Recommendation from the Council was adopted:—

"That £35 be granted to Professor A. C. Haddon, SC.D., to assist him in his Investigation of the Decorative Art of Borneo."

Donations to the Library were announced, and thanks were voted to the Donors.

Transactions, Vol. XXXI., Part 5, "The Twelfth and concluding Memoir on the 'The Theory of Screws,' with a Summary of the Twelve Memoirs." By Sir Robert S. Ball, LL.D., F.R.S., was laid on the table.

MONDAY, JANUARY 24, 1898.

MR. JOHN RIBTON GARSTIN, D.L., F.S.A., in the Chair.

Professor J. P. O'Reilly read a Paper "On the old Black Tower of Chambles, near St. Etienne (Loire)."

Mr. George Coffey, B.A.I., read a Report by Mr. Thomas Plunkett, M.R.I.A., and himself, "On the excavation of Topped Mountain Cairn, County Fermanagh."

Mr. George Coffey read also a "Report on Mr. Thomas Plunkett's Exploration of a Cairn on Belmore Mountain, County Fermanagh."

The objects obtained in excavating Topped Mountain Cairn were on exhibition.

The objects obtained on excavating the Cairn on Belmore Mountain, and a portion of a Clay Mould found in Coal Bog, were exhibited and presented to the Academy's Museum by Mr. Thomas Plunkett, M.R.I.A.

A special vote of thanks was given to Mr. T. Plunkett for his presentation to the Museum.

MONDAY, FEBRUARY 14, 1898.

DR. J. K. INGRAM, Vice-Provost of Trinity College, a Vice-President, in the Chair.

The Secretary read a Paper by Mr. R. A. Stewart Macalister, M.A., "On an Ancient Settlement in the South-West of the Barony of Corkaguiney, in the County of Kerry."

MONDAY, FEBRUARY 28, 1898.

MOST REV. DR. DONNELLY, Lord Bishop of Canea, a Vice-President, in the Chair.

Dr. Frazer exhibited and described—

1. Some Flint Implements from Antrim, and made some remarks on their probable use.
2. Some arrow points from South America in Jasper, Obsidian, &c.
3. A series of rare historical medals.

Mr. George Coffey called attention to a number of Antiquities either purchased for or recently presented to the Museum.

A vote of thanks was passed to Mr. Thomas Plunkett and Mr. R. Clark for their donations to the Museum.

WEDNESDAY, MARCH 16, 1898.

(Stated Meeting.)

SIR JOHN GILBERT, LL.D., a Vice-President, in the Chair.

The Vice-President in the Chair declared the ballot open for the election of President and Council for the ensuing year; and appointed Mr. G. Walpole and Mr. Colgan as Scrutineers.

A ballot was also opened for the election of Honorary Members, and Dr. Scharff and Mr. Craig were appointed Scrutineers.

The Secretary of the Council read the following:—

REPORT OF THE COUNCIL FOR THE YEAR 1897–8.

Since the date of the last Report the following Publications of the Academy have been issued:—

Transactions, vol. xxxi.

Part 3. "Notes on Rockall Island and Bank, with an Account of the Petrology of Rockall, and of its Winds, Currents, &c.: with Reports on the Ornithology, the Invertebrate Fauna of the Bank, and on its previous History." By the Rev. W. S. Green, M.A., and others.

Part 4. "Further Development of the Relations between Impulsive Screws and Instantaneous Screws, being the Eleventh Memoir on the 'Theory of Screws.'" By Sir Robert S. Ball, LL.D., F.R.S.

Part 5. "The Twelfth and Concluding Memoir on the 'Theory of Screws,' with a Summary of the Twelve Memoirs." By Sir Robert Ball, LL.D., F.R.S.

Proceedings.

Of the *Proceedings*, Third Series, Part 2 of Vol. IV., was published in April, 1897, and contained the following Papers:—

"A Study of the Languages of Torres Straits, with Vocabularies and Grammatical Notes." (Part 2). By Sidney H. Ray, and A. C. Haddon, M.A., D.SC. (*continued from last Part*).

"Vector Expressions for Curves." By Charles J. Joly, M.A., F.T.C.D. Part I.—"Unicursal Curves."

"On the Melting Points of Minerals." By Ralph S. Cusack.

"Concerning Marsh's Library and an Original Indulgence from Cardinal Wolsey lately discovered therein." By Rev. George T. Stokes, D.D.

And Part 3 of Vol. IV. in July, 1897, containing the following Paper:—

"On the Origin of the European Fauna." By R. F. Scharff, PH.D., B.SC., F.Z.S.

And Part 4 of Vol. IV. in December, 1897, containing the following Papers:—

"On the Homographic Divisions of Planes, Spheres, and Space, and on the Systems of Lines joining Corresponding Points." By Charles Jasper Joly, M.A., F.T.C.D.

"Human Locomotion: Variation of Velocity when Walking." By Ralph S. Cusack.

"The Effect of Change in Temperature on Phosphorescent Substances." By Ralph S. Cusack.

"The Distribution of 'Cromlechs' in the County of Clare." By Thomas Johnson Westropp, M.A.

"Discovery of Human and other Remains, with Materials similar to those of a Crannoge, high above the present Valley of the Blackwater between Lismore Castle and Cathedral." By R. J. Ussher.

"On some Human Remains recently discovered near Lismore." By D. J. Cunningham, M.D., F.R.S., and C. R. Browne, M.D.

"Report on a Prehistoric Burial near Newcastle, County of Wicklow." By George Coffey, C. Browne, M.D., and T. J. Westropp, M.A.

"On the Constitution of the Calp Shale of the neighbourhood of Dublin." By Professor J. P. O'Reilly, C.E.

"Studies in Irish Craniology: III. A Neolithic Cist Burial at Oldbridge, County of Meath." By Alfred C. Haddon, M.A., D.SC.

"On Stone Markings (Ship-Figure) recently discovered at Dowth, in the County of Meath." By George Coffey, B.A.I.

The following Publication is in the Press:—

Transactions, vol. xxxi., Part 6.

"On New Papyrus-Fragments from the Ashmolean Museum at Oxford." By Rev. John P. Mahaffy, D.D.

The following Science Grants, recommended by Council, were sanctioned by the Academy:—

£100 to a Committee consisting of Lord Rosse, Dr. G. F. FitzGerald, and Mr. E. Cullum, to assist them in carrying on the Magnetical Observatory at Valentia.

£35 to a Committee consisting of Rev. Dr. S Haughton, Dr. D. J. Cunningham, Dr. A. C. Haddon, and Dr. Charles R. Browne, to assist them in carrying on the work of the Anthropometrical Laboratory, Trinity College, Dublin, and the Ethnographical Survey of Ireland.

£12 to Mr. Henry Dixon to assist him in carrying on his investigations of the Physics of the Transpiration Current, and the Problem of the Ascent of Sap in High Trees.

£6 to a Committee consisting of Dr. E. P. Wright, Messrs. F. W. Moore, and D. M'Ardle, to assist them in the investigation of the Irish Hepaticæ.

£35 to a Committee consisting of Dr. R. F. Scharff, Messrs. G. H. Carpenter, A. R. Nichols, G. E. H. Barrett-Hamilton, R. J. Ussher, R. Lloyd Praeger, and H. Lyster Jameson, to assist them in continuing their researches into the Fauna of Ireland.

[This Grant was subsequently returned by the Grantees.]

£12 to Mr. Thomas Plunkett to assist him in exploring a large Cairn a short distance from Enniskillen.

£35 to Prof. A. C. Haddon, D.SC., to assist him in his investigation of the Decorative Art of Borneo.

The Secretary of Council reports that he has again secured Mr. Purton's assistance in the preparation of slips for the Irish Dictionary.

The Council regret that they have not been able to appoint during the past year a Todd Professor of the Celtic Languages; but they hope that before long the vacant post will be filled up.

With respect to the *Annals of Ulster*, the Editor, Rev. Dr. MacCarthy reports that the Index is nearly printed off, and that he anticipates the publication of this the final volume of the *Annals*, containing Introduction and Index, in the autumn of the present year.

The attention of the Council having been drawn to the publication of a paper in *Archæologia*, describing a valuable find of gold ornaments and other objects in the north of Ireland, they deemed it right to bring the question of the finding and the sale in London of these objects, which seemed to come under the category of treasure trove,

before the notice of the Irish Government; they accordingly drew up and forwarded a Memorial to His Excellency the Lord Lieutenant, stating the details of the case as far as at present known to them, and requesting His Excellency's aid in procuring the transfer of this find to the Academy's museum. They have received an acknowledgment of the receipt of the Memorial, which, they are informed, is under consideration. (*Vide* Appendix p. 287.)

Two additional rooms in the Museum Building have been, as was anticipated in the last Report, made available for the Academy's collections; the arrangement of which on a more systematic basis is now being carried out, and an improved system of lighting the Long Room, in which portions of the Academy's collections are exhibited, has been introduced.

The Curatorship of the Academy's Museum having for some time remained vacant, the Council was in May, 1897, requested by the Lord President of the Committee of Council on Education to make a selection from a limited number of candidates, submitted to them, for the office. They accordingly selected Mr. George Coffey, B.A.I, and he was appointed by the Lord President with the title of "Superintendent of the Collection of Irish Antiquities in the Science and Art Museum."

During the past year several important donations have been made to the Library of the Academy. Among these were the following:—

From The Earl of Crawford, his privately printed works on Proclamations.

From Rev. M. H. Close, Treasurer of the Academy, a set of valuable geological drawings by the late G. V. Du Noyer, M.R.I.A.

From Edward Perceval Wright, M.D., Secretary of the Academy, a collection of autograph letters of the first Earl of Charlemont, President of this Academy (1785), addressed to Alexander Haliday, M.D., of Belfast. This collection is specially valuable here, as it supplements the series of Charlemont correspondence presented to the Academy by James Molyneux, third Earl of Charlemont.

From the representatives of the late Thomas Coats, Esq., of Ferguslie, a copy of the valuable and elaborately illustrated work, in three quarto volumes, on the "Coinage of Scotland." By Ed. Burns, F.S.A., Scot.

The Geological Survey of Ireland has presented such of their maps as were requisite to complete the set already in the Academy Library.

A copy has been secured for the Academy of the very important work in many volumes, entitled "I Diarii di Marino Sanuto," recently printed at Venice, and of which there is no other set in Ireland.

Among the objects added to the Academy's Collection since March 16th, 1897, the following are deserving of mention:—

(1.) A Gold Unclosed Ring (called ring money) from the County Cavan.

(2.) A Gold Mediæval Brooch, with settings of coloured stones, found in the excavations of the Dublin Main Drainage Works.

(3.) Nine Wooden Traps, known as Otter Traps, from the County Fermanagh.

(4.) A Bronze Ring-Brooch; presented by Edmund Johnson, Esq., M.R.I.A.

(5.) The Upper Stone of a Quern (decorated); presented by F. M. Olpherts, Esq.

(6.) A small collection of Bronze Antiquities; purchased from T. Rothwell, Esq.

(7.) A small collection of Bronze Antiquities; purchased from Colonel Beresford Knox.

The following Members have been elected since 16th March, 1897:—

George Bryers.
Edward Parnall Culverwell, M.A., F.T.C.D.
Rev. Michael P. Hickey.
John Joly, D.SC., F.R.S.
Edwin William Lovegrove, M.A.
Rev. Thomas Mills, M.A.
Thomas Frederick Cooke Trench, D.L.

At the Stated Meeting, on the 16th March, 1897—

A. Michel Lévy,
Albert von Kölliker, HON. F.R.S.,

were elected Honorary Members in the Section of Science.

The Academy has lost by death within the year twelve Members:—

William Archer, F.R.S., elected 10th January, 1870.

Right Hon. Chichester, Baron Carlingford, K.P., elected 12th May, 1873.

Rev. Joseph Carson, D.D., Vice-Provost of Trinity College, Dublin, elected 12th February, 1838.

James Colthurst, M.A., LL.D., elected 9th February, 1885.

William James Doherty, C.E., elected 9th June, 1879.

Rev. Samuel Haughton, M.D., F.R.S., elected 24th February, 1845.

Deputy Surgeon-General Henry King, M.A., M.B., elected 9th April, 1883.

George James Knox, M.A., elected 13th February, 1837.

Rev. David Mulcahy, P.P., elected 13th February, 1888.

Edward Stamer O'Grady, M.B., M.CH., elected 8th January, 1866.

John Frazer O'Reardon, elected 13th November, 1882.

Henry Thomas O'Reilly, F.R.C.S.I., elected 12th April, 1886.

The Academy has also lost by death two Honorary Members in the Section of Science:—

Julius von Sachs, elected 16th March, 1889.

James Joseph Sylvester, elected 16th March, 1885.

And three Honorary Members in the Section of Polite Literature and Antiquities:—

Sir Edward Augustus Bond, K.C.B., elected 16th March, 1882.

Sir Augustus Wollaston Franks, K.C.B., elected 16th March, 1875.

Don Pascual Gayangos y Arce, elected 16th March, 1869.

William Archer was born the 6th May, 1827. He was the eldest child of the Rev. Richard Archer, B.A., Dublin, Vicar of Clonduff, Rathfriland, in the county of Down. He came of an old Wexford family. His grandfather was William Archer, of Wexford, and his great-great-grandfather was Henry Archer, of Ross. In the early forties Archer obtained a Bank appointment in Dublin, where, on his father's death, in October, 1849, the family settled. There seems no doubt that most of Archer's youth was spent in the pleasant and picturesque country about Rathfriland, Hilltown, and Rostrevor; on his taking up his residence in Dublin, he began to work at microscopic forms

and all his holiday time was spent in an investigation of the Flora and Fauna of the Dublin hills. About 1854 there was a small group of students in Trinity College, Dublin, who, on the invitation of Dr. R. Ball, the then Curator of the Natural History Museum of the University, met at short intervals for the practical study of Zoology. At first their studies were confined to preserved specimens; but, under the influence of Professors Allman and Harvey, microscopical work upon living forms formed the greater part of their investigation. The ponds in the Phœnix Park were their happy hunting grounds. In kindred study in the Zoological Gardens Archer met with the College workers. To their delight he told them more about the forms met with than ever they had known. He had at this time an excellent knowledge of the Dublin Desmids, and a wonderful power of diagnosing the species. Professors Allman and Harvey were delighted with their extra-academic pupil, and he was made very welcome within the College walls. His brother Richard was at this time a College student in the Law School, but neither he nor his brother Holt ever developed any special taste for biological studies. With all his diffidence Archer was no misanthrope. Nothing delighted him more than excursions made in company of some chosen friend, and it seemed quite natural that a brotherhood should be started with the object of combining a study of natural history, from a practical point of view, with a thoroughly social reunion. The Dublin Microscopical Club was the result. It was limited to twelve members. Each should be a practical worker with the microscope. The meetings were held at the houses or rooms of the members. On an election one vote against excluded. This club, founded in 1857, preserved its original code of rules and method of work until 1897 with excellent results so far as science went, and with no little advantage to its members.

In 1870 Archer was elected a member of this Academy. He filled the office of Secretary of Foreign Correspondence from 1875 to 1879. In this latter year he was awarded the Academy's Cunningham Gold Medal. He was elected a Fellow of the Royal Society in 1875. In 1877 he was elected to the Librarianship of the Royal Dublin Society. For years he had served on its Library Committee, and his qualifications for the office were strongly testified to by W. B. Carpenter, Thomas H. Huxley, W. Thiselton Dyer, and Ray Lankester, to

mention only those of his supporters not resident in Ireland. When in 1890 the greater portion of this Library was, by an agreement, transferred to the Committee of Council on Education to form the National Library for Ireland, Archer became the Principal Librarian, in which position he remained until, under the superannuation clause, he retired in 1895. At the time of his retirement Archer was in a precarious state of health, from which condition he never quite recovered; he died on the 14th of August, 1897.

Of his work as Librarian of our National Library this is not the place to speak; but some brief account of his scientific work, by which his name will be known to all future workers, is called for.

His first important work was a catalogue of the Desmids found near Dublin, which was communicated to the Dublin University Zoological and Botanical Association in January, 1857, and which was the result of investigations carried on during 1854–56. Supplements to this were published in 1858, and then, for the first time, several new species were described and figured by him. These memoirs brought Archer into correspondence with M. de Brébisson, of Falaise, and led to his being intrusted by Andrew Pritchard with the revision of the group of Desmids for his "History of Infusoria," published in 1861. From this time Archer's contributions to our knowledge of the fresh-water Chlorophyceæ were numerous. All were based on personal observation, carried on over considerable periods of time. Archer was never in a hurry to describe an apparently new form; on the contrary, he often exhibited interesting species at the meetings of the Microscopical Club without describing them, resting in the hope of getting more details. One result of this reticence has been that all such not published are now lost to science; for Archer, however good as a collector and observer, did not properly preserve his specimens, and has left no named series behind him.

It was almost impossible to investigate the minute forms of Algæ without constantly encountering the minute forms of animal life. In 1863 he discovered *Stephanosphæra pluvialis* Cohn, on Bray Head, and made the amœba-form stage of this Alga a special study. For this purpose he plunged into the whole subject of amœboid bodies, with the result that his name will be for ever associated with the life-history of the fresh-water Rhizopods and Heliozoa. The first of a remarkable series of contributions to our knowledge of these forms began in 1869,

in the Quarterly Journal of Microscopical Science (vol. ix., n. s.), "On Fresh-water Rhizopods, new or little known," and culminated in his splendid Memoir, published in our own Proceedings (vol. ii., ser. 2, Science); "On *Chlamydomyxa labyrinthuloides*, nov. gen. et spec., a new fresh-water Sarcodic Organism." The beautiful illustrations to these memoirs are all from Archer's original drawings, which he elaborated with a delicacy of touch that left it difficult to reproduce them. The period of Archer's life in which he made and published these brilliant researches was that in which he had most leisure, and in which he was freest from the ordinary cares of life. Days were spent by the flooded grounds near the Westmeath lakes, or in Connemara, or on the shores of Bantry Bay, and such excursions were ever attended by fresh discoveries; but in 1876 his whole time was devoted to his library work. Gradually the combined factors of increasing work and increasing years became too onerous for him, and for some years before his death his once favourite pursuits were completely abandoned.

The Royal Society's Catalogue of Scientific Papers enumerates 59 of his memoirs.

Rev. Joseph Carson, D.D., had a long and distinguished career in Trinity College. He obtained a Scholarship in 1833 and a Fellowship in 1837, and was co-opted as a Senior Fellow in 1866. In 1878 he was elected to the Professorship of Hebrew, and became Vice-Provost in 1890. He was an active and zealous member of his University, and faithfully served its interests. His counsel was always valued, and he had in particular a high reputation for ability as a financial administrator. Having become a member of this Academy in 1838, he was elected a member of Council in 1857, and Treasurer the same year; this office he continued to hold during the ten following years.

By the death of Dr. Samuel Haughton, on October 31st, 1897, the Academy has lost one of its most highly valued Members; one, moreover, of the oldest, as he joined on February 25th, 1845, now fifty-three years ago. His family belonged to the Society of Friends, and were natives of Carlow, in which town he was born in 1821. He displayed very early the intellectual abilities

which made him so distinguished in after-life. He entered Trinity College, Dublin, in 1838, and after a very successful undergraduate career, he was, in 1844, elected Fellow thereof, at the early age of 23, and on his first appearance as a candidate for the office. Having attained this position chiefly by mathematics and mathematical physics, he allowed his early interest in Natural History to reassert itself; and when, by the appointment of Professor Oldham to the Directorship of the Geological Survey of India, in 1851, the Chair of Geology in the University became vacant, Dr. Haughton was elected thereto as the most suitable person for the post. During the thirty years of his occupation of it, besides the instruction of his classes, he did a large amount of original work in Geology, in the form of numerous Papers which have appeared in the publications of the Royal Society of London, the Royal Irish Academy, and the Journals of the Geological Societies of London and of Ireland, &c. The composition of the granites of Ireland and of Scotland especially engaged his attention. He wrote also on various palæontological and mineralogical subjects.

His knowledge of mathematics and physics enabled him to attack sundry questions in Physiology and in Cosmology, some of which latter are still under discussion. We may here note his "Manual of Geology" (first edition, London, 1865), and his "Lectures on Physical Geography" (in the Dublin University Press series); both books being marked with his usual originality and versatility.

His studies in Palæontology suggested to him to take up the subject of human anatomy and physiology, and for this purpose he entered the Medical School and followed out its course as a young student might do, and took the degree of M.D. in 1862. He afterwards wrote various Papers in medical and other publications on physiological and pathological subjects. One result of his anatomical studies was his book on the "Principles of Animal Mechanics" (London, 1873). This work occupied his attention for a long time; it consisted principally of many Papers written on the subject during a period of ten years. This undertaking was of special interest to him; as it opened to him a new line of discovery by the application of mathematics to the structure and mode of working of the muscular system of the vertebrate animals. He obtained, in many cases, illustrations of the *Principle of Least Action* in the vertebrate organization.

This name was taken from that of the other well-known principle in dynamics and physics, which was pointed out originally by Maupertuis. The instances of this in organic and in inorganic nature, though not identical in character, are analogous, and both may be included under the head of the principle of Economy in the working of nature. Dr. Haughton showed in various instances that the arrangement and mutual position of the muscular fibres, the bones, and the joints was such as to produce the required effect with the least demand on the muscular tissue; thereby allowing the amount of that tissue, absolutely necessary for the purpose, to be at a minimum. He believed that the operation of this principle was, in certain cases, modified by other requirements, *e.g.* that of beauty of form. This subject had a particular attraction for Dr. Haughton, not only from its purely scientific, but also from its teleological aspect, as indicative of the operation of mind and purpose in nature. This work cost him great and long-continued labour for its completion. It was that on which he himself looked with most complacency, and by which, especially, he hoped to be remembered in after-time. We may here allude to his exposition in that book of the *Law of Fatigue*, from experiments on others and on himself. It seems natural that he should wish to learn more about a condition, of which, if we may judge from his indefatigable activity, he must have had in himself but an imperfect conception. We need not do more than mention the numerous elementary works, some of which were written by himself, singly, and others with the collaboration of his lifelong friend, the Rev. Professor Galbraith. These had a large circulation.

On obtaining the degree of M.D. in Dublin University he was appointed the Medical Registrar, and as such he applied himself with his usual determination and energy to the reformation of the School of Physic, and to the improvement of the management of Sir Patrick Dun's Hospital, which is connected with that School. It may well be imagined that this was a work of no little difficulty, and calculated to rouse opposition from those long accustomed to the old order of things; but his strenuous efforts were successful, and were the means of raising the School to its present condition of high efficiency. He was, moreover, largely instrumental in the organization of the School of Engineering. He was co-opted Senior Fellow of Trinity College in 1881.

His activities were by no means confined to the circle of his College duties. When Dublin was visited by cholera in 1866, he organized a system of provision against it for the poor, and invited and obtained the co-operation of the students, many of whom still live to remember his noble and inspiring speech at the inauguration meeting in the Examination Hall of Trinity College. He was representative of the University on the General Medical Council, and took a prominent and useful part in the deliberations of that body. His latest attendance at a meeting of the Council in London was at a time when his health and strength were barely sufficient for the effort. He was an active manager of the Royal Geological Society of Ireland, in the capacities of Secretary, President, and Treasurer, successively, for many years. He undertook the Secretaryship of the Royal Zoological Society of Ireland with its Zoological Gardens in 1864, at a time when some such leader as he was sorely needed to guide it through its difficulties. He worked in his usual style in that office for twenty-one years, and by his assiduity, energy, and resource he carried the Society through crises which, but for him, would probably have been fatal. He was then President of the Society for five years.

He was for thirty years, from time to time, a member of the Council of the Royal Irish Academy, and President of it from 1886 to 1891. He loyally communicated most of his principal scientific papers to the Academy, which appear in the *Transactions* and *Proceedings* thereof. In 1848 the Academy presented him with its Cunningham Gold Medal for his paper in the *Transactions* "On the Equilibrium and Motion of Solid and Fluid Bodies."

The Royal Society's Catalogue of Scientific Papers enumerates 173 of his memoirs on a great variety of subjects, besides a few written in conjunction with others. If we add his papers published by the Academy since 1883, the year to which the above Catalogue comes down, there results a total of, at least, 186.

Special attention may be drawn to his discussion, in 1854 and 1864, of the Diurnal, and of the Semidiurnal, Tides on the coasts of Ireland, founded on the tidal observations made at various stations, in 1850 and 1851, under the direction of the Academy—a very laborious and important work. He calculated also, in the publications of the Royal Society of London, the Tides of the Arctic Seas, from the observations made by various voyagers.

Dr. Haughton was a man of very remarkable personality and of unusual versatility of powers, as shown not only by his activity in so many diverse lines of science, but also by his efficiency as a man of affairs, and, we may now add, by the interest evinced by him in certain lines of literature. His brightness and hopefulness contributed largely to carrying him successfully through many of his undertakings. He was always ready to show generous encouragement to younger students in science who were carefully doing their best. His social qualities and lively humour made him always welcome to his friends; while those who were more intimate with him could prize the deeper moral qualities which underlay those by which he was recommended to outsiders.

His merits were widely recognized outside of Ireland. He was elected Fellow of the Royal Society of London in 1858. The University of Oxford conferred on him the degree of D.C.L. in 1868, and the Universities of Cambridge and of Edinburgh that of LL.D., in 1880 and 1884, respectively; and the University of Bologna that of M.D. in 1888: all *honoris causa.*

[Appendix.]

Copy of Memorial referred to in the above Report:—

To His Excellency George Henry, Earl Cadogan, K.G., Lord Lieutenant General and General Governor of Ireland.

The Memorial of the Council of the Royal Irish Academy

Showeth that—

1. The Royal Irish Academy was incorporated in 1786, by Charter of the 28th January, in the 26th year of George III., for the promotion of Science, Polite Literature, and Antiquities.

2. Since the period of its foundation, the Academy has applied itself earnestly to the advancement of these studies, and in the department of Antiquities it has specially devoted itself to the Antiquities of Ireland.

3. Owing to the constant exertions of the Academy so many

valuable Relics of Antiquity have been saved from destruction and placed in a safe and accessible position for the gratification and instruction of the lovers of ancient art, that this collection is admitted to be now one of the most important in Europe, and is all but unique in the department of prehistoric gold objects.

4. In 1859 and following years the special attention of the Government was called, both in Parliament and otherwise, to the importance of improved methods being adopted for the preservation of objects of antiquity—especially those coming under the denomination of Treasure Trove—and in 1861 the President of the Academy received a letter (2812), dated 20th April, in which Sir Thomas Larcom, Under Secretary, said:—

"Referring to the correspondence with the Royal Irish Academy, and the Report of the Council of that body on the subject of Treasure Trove in Ireland, I am directed by the Lord Lieutenant to state that the Lords Commissioners of Her Majesty's Treasury have been pleased to sanction the expenditure of one hundred pounds a year in the recovery of Relics of Antiquity, to be carried on upon a plan submitted by His Excellency, through the instrumentality of the Constabulary of the several counties. And I am directed to transmit for the information of the Academy a copy of the Instructions which have been issued for the purpose.

"His Excellency feels assured he may count upon the assistance and co-operation of the Academy in a measure so useful to the public, and calculated to add to the valuable collection already deposited in the Museum of the Academy."

[The printed documents referred to in the above letter were Circular No. 35, headed "Treasure Trove," and signed "H. J. Brownrigg." Notice dated, Dublin Castle, 20th March, 1861, and signed "T. A. Larcom"—also the Forms of receipt and Certificate of finding.]

5. The Academy willingly agreed to assist to the utmost of its power in carrying out the wishes of His Excellency, and since that time a large number of antiquities, including many torques, rings, and other gold ornaments, have been collected together; the Academy on various occasions having by special private subscriptions supplemented the funds granted by Parliament.

6. When Her Majesty's Government, in 1868, purchased, along with the entire Petrie Collection of Antiquities, the famous "Tara Brooch," the Government of the day was so deeply impressed with the fact that the Academy was the appropriate place of exhibition of these objects that they ordered them to be deposited with the Academy.

7. In like manner, on the acquisition in 1874 of another object, which for beauty of execution takes its place beside the Tara Brooch, viz. the "Ardagh Chalice," it was deposited among the collections of which the Academy is the guardian.

8. Again in 1884, when the Science and Art Department in London purchased, at the Fountaine Sale, the Reliquary of St. Lachtin, the Lords Commissioners of Her Majesty's Treasury sanctioned the transfer of £452 3*s.* 6*d.* from the Civil Contingencies Fund to the credit of the vote for the Science and Art Department in repayment of the amount expended in the purchase of the object, and deposited the shrine in its natural place with the other historic Irish antiquities.

9. From these facts it is obvious that successive Governments have felt that the Royal Irish Academy is the fitting depository of these monuments of early Irish Art.

10. On the 21st January, 1897, a Paper* was read before the Society of Antiquaries of London, by Mr. Arthur J. Evans, on a remarkable hoard of gold objects recently acquired by Mr. Robert Day, of Cork, and in the Paper Mr. Evans states that "the objects were found together by a ploughman, who turned them up in subsoiling. . . . The spot where the treasure was found is near the sea on the north-west coast of Ireland."

Mr. Evans proceeds to describe the various objects in the "find," and coming to the consideration "whether it contained relics of different periods, or that the treasure itself had been collected from more than one source by its original modern possessor," adds:— "With regard to the last possibility, Mr. Robert Day has made most careful investigations, and has completely satisfied himself as to the *bona fide* character of the find, and that all the objects were brought to light at the same place and at the same time. . . . The fine brown

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* Published in *Archæologia*, second series, vol. v., p. 391.

clay with which all the objects were more or less covered also bore out his statement as to their place of discovery."

11. It is obvious, therefore, from the above particulars that the find is *Treasure Trove*, and should have been forwarded by the finder to the Chief Secretary, or to the Academy, or delivered to the Constabulary of the district.

12. The first information which the Council of the Academy had of the matter was the report of the meeting at which the above Paper was read, which appeared in the *Athenæum* of January 30th, 1897. This report was laid before the Council at its meeting on 1st February, and the matter was referred to the Museum Committee to take such action as was possible with a view to securing the objects for the Museum, and with power to communicate with the Crown Solicitor is necessary. The Committee carefully considered the circumstances of the case as published, and both the Secretary of the Academy and the Secretary of Council had interviews with the Chief Crown Solicitor, and brought under his notice the report of the above-mentioned meeting before which the objects were laid.

13. The objects were subsequently purchased by the British Museum.

14. It appears therefore to the Council of the Academy that there has been a distinct breach of the regulations regarding treasure trove found in Ireland, and that it is a matter calling for the strictest investigation, how objects of treasure trove found in Ireland have been acquired by a museum in England without having been submitted to the Chief Secretary directly or to the Royal Irish Academy.

15. The Council feel strongly that, although the British Museum is one of the public museums of the United Kingdom, yet the proper place in which these objects should be deposited is the Royal Irish Academy's Collection in the Museum of Science and Art, Dublin, and that the Treasury should be urged to take steps for the transfer of these objects to the Museum in Dublin similar to the steps taken in 1884 for the transfer of the Shrine of St. Lachtin referred to in paragraph 8.

Your memorialists therefore respectfully request that Your Excellency may be pleased to use your influence with Her Majesty's Government with a view to having these objects, *found in Ireland*, placed along with the other Irish antiquities in the National Collection

deposited in the Science and Art Museum, Dublin, where, but for the evasion of the usual method of dealing with gold objects found in Ireland, they would already have taken their place.

In making this earnest appeal to Your Excellency the Council are not only actuated by their sense of duty with regard to the interests of the National Collection, but also feel strongly that the interests of archæology will be best served by placing these antiquities in what is admitted to be the most important collection of kindred objects, which it is desirable to render as complete as possible for the purposes of comparative study.

Signed on behalf of the President and Council of the Royal Irish Academy.

✠ N. Donnelly, Bishop of Canea, *Vice-President.*
Robert Atkinson, *Secretary of Council.*

The Report was adopted.

On the Report of the Scrutineers the following were declared duly elected as Honorary Members:—

In the Section of Science.

Paul Heinrich Groth.
Right Hon. Sir John Lubbock, Bart.
Luigi Cremona.

In the Section of Polite Literature and Antiquities.

Friedrich Blass.
Antonio Ceriani.
Louis Duchesne.
Oscar Montelius.

On the Report of the Scrutineers, the Vice-President declared the following duly elected as President and Council for the ensuing year:—

President.

Right Hon. The Earl of Rosse, K.P., LL.D., F.R.S.

Council.

Committee of Science.

Edward Perceval Wright, M.D.
Francis A. Tarleton, LL.D., D.SC.
Benjamin Williamson, D.SC.

Committee of Science—continued.

J. P. O'Reilly, C.E.
George L. Cathcart, M.A.
George Henry Kinahan, C.E.
Robert F. Scharff, B.SC., PH.D.
Greenwood Pim, M.A.
Grenville A. J. Cole, F.G.S.
Charles J. Joly, M.A.
F. W. Moore.

Committee of Polite Literature and Antiquities.

Robert Atkinson, LL.D.
Rev. Maxwell H. Close, M.A.
Sir John T. Gilbert, LL.D., F.S.A.
Louis C. Purser, M.A., LITT.D.
Most Rev. Bishop Donnelly, D.D.
Lord Walter FitzGerald.
Rev. J. H. Bernard, D.D.
John Kells Ingram, LL.D.
John Ribton Garstin, M.A., F.S.A.
Thomas J. Westropp, M.A.

A ballot was opened for the election of Officers. Count Plunkett and Mr. George L. Cathcart were appointed as Scrutineers. The following were declared elected :—

TREASURER—Rev. M. H. Close, M.A.
SECRETARY—Ed. Perceval Wright, M.D.
SECRETARY OF THE COUNCIL—Robert Atkinson, LL.D.
SECRETARY OF FOREIGN CORRESPONDENCE—Joseph P. O'Reilly, C.E.
LIBRARIAN—Sir John T. Gilbert, LL.D.
ASSISTANT SECRETARY—Robert Macalister, LL.B.

The Academy then adjourned.

LIST OF THE MEMBERS

OF THE

ROYAL IRISH ACADEMY.

INCORPORATED BY ROYAL CHARTER 1785.

1898.

DUBLIN:
PUBLISHED AT THE ACADEMY HOUSE, 19, DAWSON-ST.
SOLD ALSO
By HODGES, FIGGIS, & CO. (Ltd.), GRAFTON-ST.;
By WILLIAMS & NORGATE,
London: 14, Henrietta-street, Covent Garden.
Edinburgh: 20, South Frederick-st. Oxford: 7, Broad-st.
1898.

Price One Shilling.

[Should any errors or omissions be found in this List, which is revised to 16th May, 1898, it is requested that notice thereof may be given to the Secretary of the Academy, 19, Dawson-street, Dublin. He should also be informed of the death of any Member.]

LIST

OF THE

COUNCIL AND OFFICERS,

MEMBERS, HONORARY MEMBERS,

AND

CUNNINGHAM MEDALISTS

OF THE

Royal Irish Academy,

DUBLIN.

1898.

DUBLIN:
PUBLISHED AT THE ACADEMY HOUSE, 19, DAWSON-STREET.
SOLD ALSO
BY HODGES, FIGGIS, & CO. (LTD.), GRAFTON-ST.;
BY WILLIAMS & NORGATE,
LONDON: 14, HENRIETTA-STREET, COVENT GARDEN.
EDINBURGH: 20, SOUTH FREDERICK-ST. OXFORD: 7, BROAD-ST.
1898.

THE ROYAL IRISH ACADEMY

A.D. 1898.

Patron:

HER MAJESTY THE QUEEN.

Visitor:

HIS EXCELLENCY THE LORD LIEUTENANT OF IRELAND, K.G.

ROYAL IRISH ACADEMY.

President:

(*First elected*, 16*th of March*, 1896.)

RIGHT HON. THE EARL OF ROSSE, K.P., LL.D., F.R.S.

Vice-Presidents:

(*Nominated by the President, with the dates from which they have continuously been re-appointed.*)

(1) JOHN KELLS INGRAM, LL.D. (1896).
(2) BENJAMIN WILLIAMSON, SC.D., F.R.S. (1896).
(3) SIR JOHN THOMAS GILBERT, LL.D., F.S.A. (1897).
(4) JOHN RIBTON GARSTIN, B.D., LL.B., F.S.A. (1898).

Council:

(*Elected* 16*th of March*, 1898.)

The Council consists of the Committees of Science and of Polite Literature and Antiquities.

Committee of Science (Eleven Members):

Elected	
Nov., 1883	ED. PERCEVAL WRIGHT, M.A., M.D.
Nov., 1886	FRANCIS A. TARLETON, LL.D.
Mar., 1888	BENJAMIN WILLIAMSON, M.A., SC.D., F.R.S.
,, 1889	JOSEPH P. O'REILLY, C.E.
,, 1890	GEORGE L. CATHCART, M.A.
Nov., 1890	GEORGE H. KINAHAN, C.E.
Mar., 1893	ROBERT F. SCHARFF, B.SC., PH.D.
,, 1896	GREENWOOD PIM, M.A.
,, 1897	GRENVILLE A. J. COLE, F.G.S.
,, 1898	CHARLES J. JOLY, M.A.
,, 1898	FREDERICK W. MOORE, F.L.S.

Committee of Polite Literature and Antiquities (Ten Members):

Mar., 1875	ROBERT ATKINSON, LL.D.
Nov., 1878	REV. MAXWELL H. CLOSE, M.A.
Mar., 1888	SIR JOHN T. GILBERT, LL.D., F.S.A.
,, 1892	LOUIS C. PURSER, M.A., LITT.D.
,, 1893	MOST REV. NICHOLAS DONNELLY, D.D.
Nov., 1893	LORD WALTER FITZGERALD.
Mar., 1895	REV. JOHN H. BERNARD, D.D.
,, 1896	JOHN KELLS INGRAM, LL.D.
Nov., 1896	JOHN RIBTON GARSTIN, M.A., B.D., F.S.A.
Mar., 1898	THOMAS J. WESTROPP, M.A.

Officers:

(*Elected annually by the Academy; with date of first election.*)

Treasurer, ...	REV. MAXWELL H. CLOSE, M.A. (1878).
Secretary, ...	ED. PERCEVAL WRIGHT, M.A., M.D. (1883).
Secretary of the Council, . .	ROBERT ATKINSON, LL.D. (1878).
Secretary of Foreign Correspondence, ...	JOSEPH P. O'REILLY, C.E. (1880).
Librarian, ...	SIR JOHN T. GILBERT, LL.D. (1888).
Assistant Secretary, ...	ROBERT MACALISTER, LL.B. (1882).

(*Appointed by the Council.*)

Library Clerk and Serjeant-at-Mace, J. J. MacSWEENEY (1869).

Committees appointed by Council (1898):

Publication.

Dr. Atkinson.
Mr. Cathcart.
Rev. M. H. Close.
Sir John Gilbert.
Dr. Ingram.
Mr. C. J. Joly.
Mr. O'Reilly.
Dr. Scharff.

Library.

Dr. Atkinson.
Rev. M. H. Close.
Mr. Cole.
Sir John Gilbert.
Mr. Kinahan.
Mr. O'Reilly.
Dr. Scharff.
Mr. Westropp.
Dr. Wright.

Irish Manuscripts.

Dr. Atkinson.
Rev. Dr. Bernard.
Rev. M. H. Close.
Sir John Gilbert.
Dr. Ingram.
Dr. Purser.
Dr. Wright.

Economy and House.

Dr. Atkinson.
Rev. M. H. Close.
Sir John Gilbert.
Mr. Joly.
Mr. Kinahan.
Mr. Moore.
Mr. O'Reilly.
Mr. Pim.
Dr. Scharff.
Dr. Wright.

Representatives of the Royal Irish Academy on the Government Grant Committee of the Royal Society, London:

Right Hon. The Earl of Rosse, K.P., LL.D., D.C.L., F.R.S (1894).
Alexander Macalister, M.A., M.D., F.R.S. (1894).

Representatives of the Royal Irish Academy on the Board of Visitors of the Science and Art Museum, the Natural History Collection, and the Botanic Gardens:

John Ribton Garstin, M.A., F.S.A., D.L. (1887).
Edward Perceval Wright, M.A., M.D. (1890).
William Frazer, F.R.C.S.I. (1897).

Royal Irish Academy's Todd Professor of the Celtic Languages:

Edward J. Gwynn, M.A., F.T.C.D. (1898).

MEMBERS OF THE ROYAL IRISH ACADEMY.

The sign (*) is prefixed to the names of Life Members.

The sign (§) indicates the Members who have contributed Papers which have been published in the TRANSACTIONS or CUNNINGHAM MEMOIRS of the Academy.

Date of Election.	
1893. Feb. 13	Allingham, Hugh. *The Mall, Ballyshannon.*
1843. April 10	*§Allman, George James, M.D. (Dubl. & Oxon.); LL.D., F.L.S., F.R.C.S.I., F.R.SS. (Lond. & Edinb.); Royal Medalist, Royal Society, 1873; Cunningham Medalist, Royal Irish Academy, 1878. *Ardmore, Parkstone, Dorsetshire.*
1871. June 12	*Amherst of Hackney, Right Hon. William Amhurst Tyssen, Baron, D.L., F. S. A. *Didlington Hall, Brandon, Norfolk.*
1873. Jan. 13	Andrews, Arthur. *Newtown House, Blackrock, Co. Dublin.*
1870. April 11	Ardilaun, Right Hon. Arthur, Baron, LL.D. *Ashford, Cong, Co. Galway; St. Anne's Clontarf, Co. Dublin.*
1894. June 24	*Argall, Philip. 519, *Boston Buildings, Denver, Colorado.*
1875. Jan. 11	*ATKINSON, ROBERT, LL.D., Litt. D., Professor of Sanskrit and Comparative Philology, Dublin University; SECRETARY OF COUNCIL OF THE ACADEMY. *Clareville, Up. Rathmines, Co. Dublin.*
1895. Dec. 9	*Ball, Francis Elrington. *Taney House, Dundrum, Co. Dublin.*
1870. Jan. 10	*§Ball, Sir Robert Stawell, LL.D., F.R.S., F.R.A.S., Lowndean Professor of Astronomy and Geometry in the University of Cambridge; Cunningham Medalist, Royal Irish Academy, 1879. *The Observatory, Cambridge.*
1842. Jan. 10	*Banks, Sir John Thomas, K.C.B., M.D., LL.D.; Regius Professor of Medicine, University of Dublin. 45, *Merrion-square, Dublin.*

Date of Election.	
1889. June 24	Barklie, Robert, F.C.S. *Thornhill, Dunmurry, Belfast.*
1874. May 11	*Barrett, William F., F.R.S.E., Professor of Physics, Royal College of Science, Dublin. 6, *De Vesci-terrace, Kingstown.*
1894. April 9	Barrett-Hamilton, Gerald E. H., B.A. (Cantab.). *Kilmanock House, New Ross, Co. Wexford.*
1884. Feb. 11	*Barrington, Richard Manliffe, M.A., LL.B. *Fassaroe, Bray.*
1886. June 28	*Barry, Rev. Edmond, P.P. *Rathcormac, Co. Cork.*
1880. Feb. 9	*Barry, Michael, M.D. 16, *Albion-street, Hyde-park, London, W.*
1895. June 10	*Barry, Patrick J., L.R.C.S.I., L.K.Q.C.P.I. 50, *Merrion-square, Dublin.*
1880. Feb. 9	*Barter, Rev. John Berkeley. 21, *Via Assieta, Turin.*
1865. Jan. 9	*Beauchamp, Robert Henry. 25, *Fitzwilliam-square, South, Dublin.*
1884. May 12	Bell, Hamilton. 5, *Churchill-terrace, Sandymount.*
1868. April 27	*Belmore, Right Hon. Somerset Richard, Earl of, M.A., D.L. K.C.M.G. *Castle Coole, Enniskillen.*
1866. June 11	§Bennett, Edward Hallaran, M.D., M. Ch., F.R.C.S.I.; Professor of Surgery in the University of Dublin. 26, *Lower Fitzwilliam-street, Dublin.*
1889. April 8	§Bernard, Rev. John Henry, D.D.; Fellow of Trinity College, and Archbishop King's Lecturer in Divinity in the University of Dublin. 82, *Lower Leeson-street, Dublin.*
1894. Feb. 12	Bigger, Francis Joseph. *Ardrie, Belfast.*
1887. Jan. 10	Birch, Rev. John George, M.A. *Kilfinaghty Glebe, Bunratty, Co. Clare.*
1854. April 10	*Brady, Cheyne. *Chalet des Syrphes, Cannes.*
1889. June 24	Brenan, James, R.H.A. 8, *Palmerston-road, Rathmines.*
1892. June 13	Browne, Charles R., M.D. 66, *Harcourt-street, Dublin.*
1886. April 12	Browne, William James, M.A. (Lond.), 5, *Crawford-square, Londonderry.*
1897. April 12	Bryers, George, 41, *Kenilworth-square, Rathgar, Co. Dublin.*
1889. June 24	Buick, Rev. George Raphael, M.A., LL.D. *Cullybackey, Co. Antrim.*

Date of Election.	
1887. Jan. 10	Burbidge, Frederick William, M.A., F.L.S. 91, *Haddington-road, Dublin.*
1888. April 9	Burtchaell, George Dames, M.A., LL.B. 7, *St. Stephen's-green, Dublin.*
1876. May 8	Byrne, William H., C.E. *Oakfield, Ailesbury-road, Co. Dublin.*
1887. Jan. 10	Carroll, Thomas. *The Albert Agricultural Institution, Glasnevin.*
1876. Jan. 10	Carton, Richard Paul, Q.C. 35, *Rutland-square, West, Dublin.*
1878. May 13	*Cathcart, George Lambert, M.A., Fellow of Trinity College, Dublin. 106, *Lower Baggot-street, Dublin.*
1876. April 10	*Clarke, Rev. Francis E., M.A., M.D., LL.D., M.K.Q.C.P.I., M.R.C.S.E. *The Rectory, Boyle, Co. Roscommon.*
1867. May 13	*Close, Rev. Maxwell H., M.A., F.G.S., Treasurer of the Academy. 38, *Lower Baggot-street, Dublin.*
1885. Dec. 14	*Cochrane, Robert, F.S.A., F.R.I.B.A., F.R.S.N. Aqq., Hon. Sec. Royal Society of Antiquaries of Ireland. 17, *Highfield-road, Rathgar, Co. Dublin.*
1886. Feb. 8	§Coffey, George, A.I.B. (Dubl.), Superintendent of Irish Antiquities, Museum of Science and Art, Dublin. 5, *Harcourt-terrace, Dublin.*
1893. Feb. 13	*§Cole, Grenville Arthur James, F.G.S., Professor of Geology, Royal College of Science, Dublin. 3, *Uxbridge-terrace, Leeson Park.*
1894. April 9	Colgan, Nathaniel. 1, *Belgrave-road, Rathmines, Co. Dublin.*
1895. April 8	Colles, Ramsay. 1, *Wilton-terrace, Dublin.*
1882. June 26	*Collum, Rev. Hugh Robert, F.S.S. *Leigh Vicarage, Tonbridge, Kent.*
1885. June 8	Conlan, Very Rev. Robert F. (Canon), P.P. *Presbytery, Halston-street, Dublin.*
1866. April 9	Cooper, Lieut.-Col. Edward Henry, H. M. Lieutenant, County Sligo. *Markree Castle, Collooney, Co. Sligo.*
1878. June 24	Corbet, William Joseph, M.P. *Springfarm, Delgany.*
1864. May 9	*Cotton, Charles Philip, B.A., C.E. *Ryecroft, Bray.*
1895. June 10	*Cowan, Samuel William Percy, M.A. (Dubl.). *Craigavad, Co. Down.*

Date of Election.	
1876. April 10	*Cox, Michael Francis, M.D., L.R.C.S.I. 45, *St. Stephen's-green, East, Dublin.*
1896. April 13	Craig, William Alexander. *Prospect House, Clontarf, Co. Dublin.*
1884. May 12	Cranny, John Joseph, B.A., M.D., F.R.C.S.I. 17, *Merrion-square, North, Dublin.*
1886. Jan. 11	Crawford, Robert, M.A., M.E. *Stonewold, Ballyshannon, Co. Donegal.*
1866. June 11	*Cruise, Sir Francis Richard, M.D., F.K.Q.C.P.I., M.R.C.S.E. 93, *Merrion-square, West, Dublin.*
1897. April 12	Culverwell, Edward Parnall, M.A., Fellow of Trinity College, Dublin. *The Hut, Thormanby-road, Howth, Co. Dublin.*
1885. Dec. 14	*§Cunningham, Daniel John, D.Sc., M.D. (Edin. and Dubl.), D.C.L. (Oxon.), F.R.S., Professor of Anatomy in the University of Dublin. 43, *Fitzwilliam-place, Dublin.*
1876. Nov. 13	*Dalway, Marriott R., D.L. *Bella Hill, Carrickfergus.*
1886. June 28	Dames, Robert Staples Longworth, B.A. (Dubl.) 21, *Herbert-street, Dublin.*
1858. April 11	*Davies, Francis Robert, K.J.J. *Hawthorn, Carysfort-avenue, Blackrock, Co. Dublin.*
1855. May 14	*§Davy, Edmund William, M.A., M.D., Prof. of Med. Jurisprudence, Royal College of Surgeons, Ireland. *St. Helen's, Highfield-road, Rathgar, Co. Dublin.*
1893. April 10	*Dawson, Henry Gordon, M.A. *Christ's College, Cambridge.*
1876. Jan. 10	Day, Robert, F.S.A. *Myrtle Hill House, Cork.*
1876. Jan. 10	Deane, Sir Thomas Newenham, R.H.A., F.R.I.A.I.' 3, *Upper Merrion-street, Dublin.*
1884. Feb. 11	*Delany, Very Rev. William, S.J., LL.D. *University College, Stephen's-green, S., Dublin.*
1876. Jan. 10	*§Doberck, William, Ph. D. *The Observatory, Hong Kong.*
1885. April 13	Donnelly, Most Rev. Nicholas, D.D., Lord Bishop of Canea. *St. Cronan's, Bray, Co. Dublin.*
1891. Dec. 14	*Doyle, Pat., F.G.S., F.R.S.E. 19, *Lall Bazar, Calcutta.*
1867. Feb. 11	Ellis, George, M.B., F.R.C.S.I. 91, *Lower Leeson-street, Dublin.*
1893. Feb. 13	*Evans, Rev. Henry, D.D. *Seamount, Howth, Co. Dublin.*

Date of Election.	
1891. Jan. 12	*Ewart, Lavens Mathewson. *Glenbank House, Ballysillan, Belfast.*
1896. Feb. 10	Falkiner, Caesar Litton, M.A. (Dub.). 9, *Upper Merrion-street, Dublin.*
1895. Jan. 14	Falkiner, Rev. William Frederick, M.A. *Killucan Rectory, Co. Westmeath.*
1867. April 8	*Farrell, Thomas A., M.A. 87, *Merrion-sq., East.*
1891. Jan. 12	*ffrench, Rev. James Frederick Metge. *Ballyredmond House, Clonegal, Co. Carlow.*
1878. Feb. 11	FitzGerald, George Francis, M.A., F.R.S., Fellow of Trinity College, and Erasmus Smith's Professor of Natural and Experimental Philosophy in the University of Dublin. 7, *Ely-place, Dublin.*
1890. April 14	FitzGerald, Lord Walter. *Kilkea Castle, Mageney, Co. Kildare.*
1887. Jan. 10	*FitzPatrick, Louis, M.R.C.S., L.R.C.S. Edinb. *Dubbo, New South Wales.*
1876. Feb. 14	Fottrell, George. 8, *North Great George's-street, Dublin.*
1866. May 14	*Frazer, William, F.R.C.S.I., Hon. Mem. Soc. Atiq. Scot. 20, *Harcourt-street, Dublin.*
1865. April 10	Freeland, John, M.D., Government Medical Officer, *Antigua, West Indies.*
1873. April 14	*Frost, James. *Ballymorris, Cratloe, Co. Clare.*
1875. June 14	Furlong, Nicholas, M.D. *Lymington, Enniscorthy.*
1880. June 28	Gannon, John Patrick. *Laragh, Maynooth, Co. Kildare.*
1863. Feb. 9	*Garstin, John Ribton, M.A., B.D., LL.B., F.S.A., F.R. Hist. Soc., D.L. *Braganstown, Castlebellingham, Co. Louth.*
1855. April 9	*GILBERT, SIR JOHN THOMAS, LL.D., F.S.A., R.H.A., Cunningham Medalist, Royal Irish Academy, 1862. LIBRARIAN OF THE ACADEMY. *Villa Nova, Blackrock, Co. Dublin.*
1875. April 12	*Gore, John Ellard, C.E., A.I.C.E., F.R.A.S., 3, *St. Mary's-road, Dublin.*
1848. June 12	*Graham, Andrew, M.A. *Observatory, Cambridge.*
1887. April 24	*§Graves, Right Rev. Charles, D.D., D.C.L., F.R.S., Lord Bishop of Limerick. *The Palace, Henry-street, Limerick.*
1887. June 27	Gray, Richard Armstrong, C.E., M.I.C.E.I. *Fortfield House, Upper Rathmines.*
1874. Feb. 9	Gray, William. *Glenburn-park, Belfast.*

Date of Election.	
1887. May 9	Green, Surgeon Captain James Sullivan, M.B. *Benares, India.*
1896. June 8	Green, Thomas George Hennis. *Lisnegar, Temple Gardens, Rathmines, Co. Dublin.*
1895. Dec. 9	Green, Rev. William Spotswood, M.A. (Dubl.). 5, *Cowper Villas, Rathmines.*
1893. April 10	*Greene, George Edward Joseph, L.R.C.S.I., L.R.C.P.I., F.L.S. *Monte Vista, Ferns, Co. Wexford.*
1894. April 9	Greening, Linnæus. 5, *Wilson-Patten-street, Warrington.*
1882. Dec. 11	Greer, Thomas. *Grove House, Regent's-park, London, N.W.*
1896. April 13	*Gwynn, Edward John, M.A., Fellow of Trinity College, Dublin, Royal Irish Academy's Todd Professor of the Celtic Languages. *Trinity College, Dublin.*
1887. Jan. 10	§Gwynn, Rev. John, D.D., Regius Professor of Divinity, University of Dublin. *Ashbrook, Clontarf, Co. Dublin.*
1884. Jan. 14	§Haddon, Alfred Cort, M.A., F.Z.S., Professor of Zoology in the Royal College of Science for Ireland. *Inisfail, Hill's-road, Cambridge.*
1875. Jan. 11	Hamilton, Edward, M.D., F.R.C.S.I. 120, *St. Stephen's-green, West, Dublin.*
1879. Dec. 8	Hamilton, Edwin, M.A. 41, *Leeson-park, Dublin.*
1893. May 8	§Hart, Henry Chichester, B.A., F.L.S. *Carrablagh, Portsalon, Co. Donegal.*
1861. May 13	*Hatchell, John, M.A., D.L. *Fortfield House, Terenure, Co. Dublin.*
1852. April 12	*Head, Henry Haswell, M.D., F.K.Q.C.P.I., F.R.C.S.I. *Thornhill, Bray.*
1896. April 13	Head, John Merrick, F.R.G.S. *Reigate, Surrey.*
1888. Feb. 13	Healy, Most Rev. John, D.D., LL.D., Lord Bishop of Clonfert. *Mount St. Bernard, Ballinasloe, Co. Galway.*
1893. Feb. 13	Hemphill, Rev. Samuel, D.D., Professor of Biblical Greek in the University of Dublin. *Birr Rectory, Parsonstown.*
1851. Jan. 13	*§Hennessy, Henry, F.R.S. *Clarens, Montreux, Switzerland.*
1897. April 12	Hickey, Rev. Michael P., Professor of Gaelic, Maynooth. *St. Patrick's College, Maynooth.*
1873. Jan. 13	Hickie, Lieut.-Col. James Francis. *Slevoyre, Borrisokane, Co. Tipperary.*

Date of Election.	
1875. Jan. 11	*Hill, Arthur, B.E., F.R.I.B.A. 22, *George's-street, Cork.*
1888. Feb. 13	Hill, Richard Cotton Walker, LL.B. (Dubl.). 7, *Grantham-street, Dublin.*
1890. Feb. 10	Hogan, Rev. Edmund, S.J., Fellow of the Royal University of Ireland, D.Litt. (Royal Univ.). *University College, St. Stephen's-green, S., Dublin.*
1898. May 9	Hore, Philip Herbert. 4, *Bath-road, Bedford-park, London, W.*
1888. Dec. 10	*Hutch, Very Rev. William (Canon), D.D., President of St. Colman's College. *St. Colman's College, Fermoy.*
1890. Jan. 13	*Hyde, Douglas, LL.D. *Frenchpark, Co. Roscommon.*
1847. Jan. 11	*Ingram, John Kells, LL.D., Vice-Provost, Trinity College, Dublin. 38, *Upper Mount-street, Dublin.*
1879. April 14	Ingram, Thomas Dunbar, LL.D. 13, *Wellington-road, Dublin.*
1873. Dec. 8	*Iveagh, Right Hon. Edward Cecil, Baron, K.P., LL.D., D.L. 80, *St. Stephen's-green, S., Dublin.*
1867. April 8	*Jephson, Robert H. 13, *Lansdowne-road, Dublin.*
1897. Jan. 11	Johnson, Edmond. *Nullamore, Milltown, Co. Dublin.*
1893. April 10	Johnson, Thomas, D.Sc., F.L.S., Professor of Botany, Royal College of Science, Dublin. *Inglewood, Gilford-rd., Sandymount, Co. Dublin.*
1893. April 10	Johnston, James Patrick, M.A. *Churchtown Park, Dundrum, Co. Dublin.*
1895. Jan. 14	*§Joly, Charles Jasper, M.A., Fellow of Trinity College, Dublin, and Royal Astronomer of Ireland. *The Observatory, Dunsink, Co. Dublin.*
1897. June 28	Joly, John, Sc.D., F.R.S., Professor of Geology, University of Dublin. *Trinity College, Dublin.*
1863. Jan. 12	*Joyce, Patrick Weston, LL.D. *Lyre na Grena, Leinster-road, Rathmines, Co. Dublin.*
1878. May 13	*Kane, John F. *Airlie Lodge, Ridgeway Gardens, Wimbledon, Surrey.*
1873. Dec. 8	*Kane, Robert Romney, M.A., LL.D., County Court Judge. 4, *Fitzwilliam-place, Dublin.*
1865. April 10	Kane, William Francis De Vismes, M.A. *Drumreaske House, Monaghan.*
1870. June 13	*Keane, Major John P., C.E., Engineer, Public Works Department, Bengal.

Date of Election.	
1870. May 23	*Kelly, John, L.M. (Dubl.). *University College Hospital, Calcutta.*
1846. April 13	*Kennedy, James Birch. *Cara, by Killarney.*
1868. Jan. 13	Kinahan, George Henry, C.E. *Woodlands, Fairview, Co. Dublin.*
1863. April 13	*Kinahan, Thomas William, M.A. 24, *Waterloo-road, Dublin.*
1888. Feb. 12	Knott, John Freeman, M.A., M.D., F.R.C.S.I. 34, *York-street, Dublin.*
1888. Dec. 10	Knowles, William J. *Flixton-place, Ballymena.*
1895. April 8	Knox, Hubert Thomas. *Beechen, Lyndhurst, Hants.*
1864. April 11	*Lalor, John J. 142 *Leinster-road, Rathmines, Co. Dublin.*
1864. Jan. 11	*La Touche, John James Digges, M.A., LL.D. 1, *Ely-place, Upper, Dublin.*
1857. April 13	*Leach, Lieut.-Colonel Sir George Archibald, K.C.B., R.E. 6, *Wetherby Gardens, South Kensington, London, S.W.*
1870. June 13	*Leonard, Hugh, F.G.S. 24, *Mount Merrion-avenue, Blackrock, Co. Dublin.*
1896. April 13	Lett, Rev. Henry William, M.A. *Aghaderg Glebe, Loughbrickland, Co. Down.*
1868. April 27	*Little, James, M.D., L.R.C.S.I., F.K.Q.C.P.I. 14, *St. Stephen's-green, North, Dublin.*
1875. April 12	Lombard, James Fitzgerald. *South-hill, Rathmines, Co. Dublin.*
1883. Feb. 12	Longfield, Thomas Henry, F.S.A., Keeper, Art and Industrial Collections, Science and Art Museum, Dublin. 19, *Harcourt-street, Dublin.*
1897. May 10	Lovegrove, Edwin William, M.A. (Oxon.). *Trent College, Long Eaton, Derbyshire.*
1878. Feb. 11	*Lowry, Robert William, B.A. (Oxon.), D.L. *Pomeroy House, Pomeroy, Co. Tyrone.*
1895. June 10	Lunham, Lieutenant-Colonel Thomas Ainslie, M.A. (Dubl.). *Ardfallen, Douglas, Co. Cork.*
1873. April 14	*§Macalister, Alexander, M.A. (Cantab.); M.D. (Dubl. & Cantab.); LL.D. (Glasg.); D. Sc. (Dubl.), F.R.S., F.S.A., Fellow of St. John's College, and Professor of Anatomy in the University of Cambridge. *Torrisdale, Cambridge.*

Date of Election.	
1871. Feb. 13	*Macartney, John William Ellison, D.L. *The Palace, Clogher.*
1884. May 12	*§MacCarthy, Rev. Bartholomew, D.D., P.P. *Inniscarra, Co. Cork.*
1891. June 8	*MacEnerny, Rev. Francis, C.C. 107, *Haddington-road, Dublin.*
1871. April 10	Macnaghten, Colonel Sir Francis Edmund, Bart., Lieutenant of Co. Antrim. *Dundarave, Bushmills, Co. Antrim.*
1874. Feb. 9	McClure, Rev. Edmund, M.A., Secretary, Society for Promoting Christian Knowledge. 80, *Eccleston-square, London, S.W.*
1896. May 11	McCrea, Rev. Daniel F. *Maghera, Co. Derry.*
1873. Jan. 13	*McCready, Rev. Christopher, D.D. *Howth, Co. Dublin.*
1864. April 11	*McDonnell, Alexander, M.A., C.E. *Saltwell Hall, Gateshead-on-Tyne.*
1882. Feb. 13	McHenry, Alexander, Geologist, Geological Survey of Ireland. 59, *Tritonville-road, Sandymount, Co. Dublin.*
1896. April 13	M'Keefry, Rev. Joseph, C.C. *Waterside, Derry.*
1898. May 9	McKenna, Rev. James Edward, C.C. *Enniskillen.*
1884. Jan. 14	McTernan, Rev. Stephen, P.P. *Killasnet, Manorhamilton, Co. Leitrim.*
1893. Feb. 13	§Mahaffy, Rev. John Pentland, D.D., Fellow of Trinity College, and Professor of Ancient History in the University of Dublin. 38, *North Great George's-street, Dublin.*
1874. Feb. 9	§Malet, John Christian, M.A., F.R.S., Cunningham Medalist, Royal Irish Academy, 1885, Assistant Commissioner, Intermediate Education Board for Ireland. 1, *Hume-st., Dublin.*
1865. April 10	*Malone, Rev. Sylvester, P.P. *Kilrush, Co. Clare.*
1879. Feb. 10	Meldon, Austin, M.D., D.L. 15, *Merrion-square, North, Dublin.*
1887. Dec. 12	*Milligan, Seaton Forrest. *Alberta, Malone-road, Belfast.*
1891. April 13	*Mills, James. *Annamore, Blackrock, Co. Dublin.*
1898. Jan. 10	Mills, Rev. Thomas, M.A. (Dubl.). *Beaconsfield, Kilmainham, Co. Dublin.*
1884. May 12	*Molloy, William Robert. 17, *Brookfield-terrace, Donnybrook.*
1887. Jan. 10	Moore, Frederick William, F.L.S. *Royal Botanic Gardens, Glasnevin.*
1898. May 9	Moran, John, M.A., LL.D. (Roy. Univ.). 12, *Gardiner's-place, Dublin.*

Date of Election.	
1869. Feb. 8	*Moran, His Eminence Patrick F., Cardinal, D.D., Archbishop of Sydney. *New South Wales.*
1874. Feb. 9	§Moss, Richard Jackson, F.C.S., F.I.C. *St. Aubyns, Ballybrack, Co. Dublin.*
1898. April 10	*Mukhopâdhyây, Asutosh, M.A., LL.D., F.R.A.S., F.R.S.E. 77, *Russa-road, North, Bhowanipore, Calcutta.*
1887. Nov. 14	Mulhall, John. 14, *Earlsfort-terrace, Dublin.*
1895. June 10	Murphy, Rev. James Edward Harnett, M.A. (Dubl.). *Rathcore Rectory, Enfield, Co. Meath.*
1898. April 10	*Murphy, Michael M. *Troyswood, Kilkenny.*
1887. May 9	*Nichols, Albert Russell, B.A. (Cantab.). *Science and Art Museum, Dublin.*
1878. Jan. 18	Nolan, Joseph, Senior Geologist, Geological Survey of Ireland. 111, *Strand-road, Sandymount, Co. Dublin.*
1846. Jan. 12	*Nugent, Arthur R. *Quintin Lodge, Leamington.*
1869. June 14	*O'Brien, James H. *St. Ita's, Newtownpark, Blackrock, Co. Dublin.*
1875. Jan. 11	O'Callaghan, John J., F.R.I.A.I. 16, *Nassau-street, Dublin.*
1867. June 10	O'Conor Don, Right Hon. Charles Owen O'Conor, The, H. M. Lieutenant, County Roscommon. *Clonalis, Castlerea.*
1892. April 11	O'Doherty, Rev. Philip, C.C. *Moville, Co.* Londonderry.
1867. Jan. 14	*O'Donel, Charles J. 47, *Lower Leeson-street, Dublin.*
1865. April 10	*O'Donnavan, William John, LL.D. 15, *Belgrave-road, Rathmines, Co. Dublin.*
1895. Jan. 14	O'Donoghue, Rev. Denis, P.P. *St. Brendan's, Ardfert, Co. Kerry.*
1869. April 12	O'Ferrall, Ambrose More, D.L, *Balyna, Moyvalley R.S.O., Co. Kildare.*
1892. Dec. 12	Ogilvie, James. *Warren's-place, Cork.*
1892. Dec. 12	*O'Growney, Rev. Eugene. *St. Patrick's College, Maynooth, Co. Kildare.*
1869. April 12	O'Hanlon, Very Rev. John (Canon), P.P. *Sandymount, Co. Dublin.*
1878. Feb. 11	O'Hanlon, Michael, L.K.Q.C.P.I. *Castlecomer, Co. Kilkenny.*
1869. April 12	*O'Laverty, Rev. James, P.P. *Holywood, Co. Down.*

Date of Election.	
1876. Feb. 14	Olden, Rev. Thomas, D.D. *Ballyclough Vicarage, Mallow, Co. Cork.*
1871. April 10	O'Looney, Brian, F.R.H.S. *Grove-villa House, Crumlin, Co. Dublin.*
1892. April 11	O'Neill, William Patrick. 58, *Great Charles-street, Dublin.*
1896. Jan. 13	*O'Reilly, Very Rev. Hugh, President St. Colman's College, Newry. *Violet Hill, Co. Armagh.*
1870. Jan. 10	*§O'Reilly, Joseph P., C.E., Professor of Mining and Mineralogy, Royal College of Science, Dublin, Secretary of Foreign Correspondence of the Academy. 58, *Park-avenue, Sandymount, Co. Dublin.*
1879. May 12	O'Rorke, Very Rev. Terence, D.D., P.P. *Collooney, Co. Sligo.*
1896. April 13	O'Sullivan, Alexander Charles, M.A., M.B., Fellow of Trinity College, Dublin. 40, *Trinity College, Dublin.*
1873. Feb. 10	Patterson, William Hugh. *Garranard, Strandtown, Co. Down.*
1847. Feb. 8	*Pereira, Rev. Henry Wall, M.A., F.S.A. Scot. *Wells, Somerset.*
1863. April 13	*Pigot, David Richard, M.A., Master of the Queen's Bench Division. *Churchtown House, Dundrum, Co. Dublin.*
1870. April 11	Pigot, Thomas F., C.E. 14, *Fitzwilliam-place, Dublin.*
1886. Feb. 8	Pim, Greenwood, M.A., F.L.S. *Easton Lodge, Monkstown, Co. Dublin.*
1884. Feb. 11	*Plunkett, George Noble, Count of the Roman States. 26, *Upper Fitzwilliam-street, Dublin.*
1896. Feb. 10	Plunkett, Lieut.-Colonel George T. (Royal Engineers, retired), Director, Museum of Science and Art, Dublin. 24, *Burlington-road, Dublin.*
1880. Feb. 9.	Plunkett, Thomas. *Enniskillen.*
1892. June 13	Polson, Thomas R. J., F.R.S.A., Ireland. 13, *Wellington-place, Enniskillen.*
1873. Jan. 13	*Porter, Alexander, M.D., F.R.C.S., Indian Army, *New Club, Cheltenham.*
1875. April 12	*Powerscourt, Right Hon. Mervyn, Viscount, K.P., President, Royal Dublin Society. *Powerscourt, Enniskerry, Bray.*

Date of Election.	
1891. April 18	Praeger, Robert Lloyd, B.E. *National Library, Dublin.*
1897. Jan. 11	Preston, Thomas, M.A., Fellow of the Royal University of Ireland. *Bardowie, Orwell Park, Rathgar.*
1874. Dec. 14	*Purcell, Matthew John. *St. Stephen's-green Club, Dublin.*
1890. Jan. 18	Purser, Frederick, M.A., Fellow of Trinity College, Dublin. *Rathmines Castle, Co. Dublin.*
1858. Jan. 11	Purser, John, M.A., D.Sc., LL.D. (Edin.); Fellow of the Royal University of Ireland; Professor of Mathematics, Queen's College, Belfast. *Queen's College, Belfast.*
1884. June 28	*Purser, Louis Claude, M.A., Litt. D., Fellow of Trinity College, Dublin. 11, *Harcourt-terrace, Dublin.*
1881. April 11	*Quinlan, Francis John Boxwell, B.A., M.D., F.K.Q.C.P.I. 29, *Lower Fitzwilliam-street, Dublin.*
1892. June 27	*§Rambaut, Arthur Alcock, M.A., D.Sc., Radcliffe Observer, University of Oxford. *Radcliffe Observatory, Oxford.*
1896. April 18	Redington, Right Hon. Christopher Talbot, B.A. (Oxon.), D.L., Vice-Chancellor of the Royal University of Ireland; Resident Commissioner of National Education in Ireland. *Tyrone House, Dublin.*
1878. June 24	*Reynell, Rev. William Alexander, B.D. 22, *Eccles-street, Dublin.*
1898. Dec. 11	Reynolds, James Emerson, M.D., Sc.D., F.R.S., Professor of Chemistry, University of Dublin. *Burleigh House, Burlington-road, Dublin.*
1876. Jan. 10	*Ross, Rev. William, M.A. 163, *Hill-street, W., Glasgow.*
1870. Nov. 30	Rosse, Right Hon. Laurence, Earl of, K.P., D.C.L., LL.D., F.R.S., F.R.A.S., Chancellor of the University of Dublin, H. M. Lieutenant, King's County, President of the Academy. *Birr Castle, Parsonstown.*
1898. Feb. 18	§Russell, Robert, M.A., Fellow of Trinity College, Dublin. 11, *Northbrook-road, Dublin.*
1885. Dec. 14	*Rylands, Thomas Glazebrook, F.S.A., F.R.A.S., F.C.S. *Highfields, Thelwall, near Warrington.*

Date of Election.	
1848. Jan. 9	*§Salmon, Rev. George, D.D. (Dubl. and Edin.); D.C.L. (Oxon.), LL.D. (Cantab.), F.R.S., and Royal Medalist, 1868, Copley Medalist, 1889, Royal Society; Cunningham Medalist, Royal Irish Academy, 1858, Provost of Trinity College. *Provost's House, Trinity College, Dublin.*
1888. Feb. 13	*Scharff, Robert F., B.Sc., Ph.D., Keeper, Natural History Collections, Science and Art Museum, Dublin. *Tudor House, Dundrum, Co. Dublin.*
1890. April 14	*Scriven, Rev. Rowland, M.A. (Cantab.) 33, *St. Stephen's-green, Dublin.*
1888. April 9	*Sellors, Edward Marmaduke, M.A., 2, *Neptune-terrace, Sandycove, Co. Dublin.*
1887. June 13	*Semple, James Charles. 2, *Marine-terrace, Kingstown, Co. Dublin.*
1846. Feb. 9	*Sherrard, James Corry. 7, *Oxford-square, Hyde Park, London.*
1888. Dec. 11	*Sibthorpe, Surgeon Major-General Charles, F.K.Q.C.P., Professor of Surgery, Madras Medical College. *Madras.*
1877. Dec. 10	*Smith, Charles. *Harpenden, St. Alban's.*
1891. Feb. 9	*Smith, Joseph. *Rose Villa, Latchford, near Warrington.*
1876. June 26	Smith, Rev. Richard Travers (Canon), D.D. *The Vicarage, Clyde-road, Dublin.*
1887. Jan. 10	§Sollas, William Johnson, M.A., D.Sc. (Cantab.), LL.D. (Dub.), F.R.S., Professor of Geology, University of Oxford. 169, *Woodstock-road, Oxford.*
1871. June 12	§Stokes, Whitley, LL.D., (Dubl.); D.C.L. (Oxon.); C.S.I., Cunningham Medalist, Royal Irish Academy, 1862. 15, *Grenville-place, Cornwall Gardens, London, S.W.*
1857. June 8	*§Stoney, Bindon B., M.A., LL.D., C.E., F.R.S. 14, *Elgin-road, Dublin.*
1856. April 14	*§Stoney, George Johnstone, M.A., D.Sc., F.R.S. 8, *Upper Hornsey Rise, London, N.*
1871. Jan. 9	Symons, John, 198, *Coltman-street, Hull.*
1892. April 11	Tait, Ven. Andrew, D.D., LL.D., F.R.S.E., Archdeacon of Tuam. *Moylough Rectory, Co. Galway.*
1877. April 9	§Tarleton, Francis Alexander, LL.D., D.Sc., Fellow of Trinity College, and Professor of Natural Philosophy in the University of Dublin. 24, *Upper Leeson-street, Dublin.*

Date of Election.	
1882. Feb. 13	*Tenison, Charles MacCarthy. *Union Bank of Australia, Brisbane.*
1869. April 12	*§Tichborne, Charles Roger C., Ph.D., LL.D., F.C.S. 15, *North Great George's-street, Dublin.*
1897. June 14	Trench, Thomas Frederick Cooke, D.L. *Millicent, Sallins, Co. Kildare.*
1894. Feb. 12	Trouton, Frederick T., Sc.D., F.R.S. *Caerleon, Killiney, Co. Dublin.*
1898. May 9	Truell, Henry Pomeroy, M.B. (Dubl.), F.R.C.S.I., D.L. *Clonmannon, Ashford, Co. Wicklow.*
1870. Nov. 30	Ventry, Right Hon. Dayrolles Blakeney, Baron, D.L. *Burnham, Dingle, Co. Kerry.*
1892. Dec. 12	Vinycomb, John. *Holywood, Co. Down.*
1892. April 11	*Waldron, Laurence A. 58, *Wellington-road, Dublin.*
1888. Feb. 13	Walpole, George. *Windsor Lodge, Monkstown, Co. Dublin.*
1884. May 12	Walsh, Most Rev. William J., D.D., Lord Archbishop of Dublin. *Archbishop's House, Drumcondra-road, Dublin.*
1881. Feb. 14	*Ward, Francis Davis. 28, *Elmwood-avenue, Belfast.*
1894. Dec. 10	Westropp, Thomas Johnson, M.A., C.E. 77, *Lower Leeson-street, Dublin.*
1866. April 9	Westropp, William Henry Stacpoole, L.R.C.S.I., F.R.G.S.I. *Lisdoonvarna, Co. Clare.*
1880. Feb. 9	*White, John Newsom. *Rocklands, Waterford.*
1874. June 8	Wigham, John R. 35, *Capel-street, Dublin.*
1873. April 14	Wilkinson, Thomas. *Enniscorthy, Co. Wexford.*
1877. April 9	§Williamson, Benjamin, M.A., D.Sc., F.R.S., Senior Fellow of Trinity College, Dublin. 1, *Dartmouth-road, Dublin.*
1888. June 25	*Wilson, Wesley William, C.E. 72, *Wodehouse-terrace, North Circular-road, Dublin.*
1888. June 25	*Wilson, William Edward, F.R.S. *Daramona, Streete, Rathowen, Co. Westmeath.*
1884. May 12	Wood-Martin, Colonel William Gregory, D.L., A.D.C. to the Queen. *Cleveragh, Sligo.*
1890. May 12	*Woollcombe, Robert Lloyd, M.A., LL.D. (Dublin Univ.), LL.D. (Royal Univ.), F.I. Inst., F.S.S., F.R.S.A., Ireland. 14, *Waterloo-road, Dublin.*

Date of Election.	
1857. Aug. 24	*§Wright, Edward Perceval, M.A., M.D. (Dubl.); M.A. (Oxon.); F.L.S., F.R.C.S.I.; Cunningham Medalist, Royal Irish Academy, 1888; Professor of Botany and Keeper of the Herbarium, University of Dublin; Secretary of the Academy. 5, *Trinity College.*
1889. Jan. 14	*Young, Charles Grove, M.A., M.D. 14, *Clapham Mansions, Clapham Common, London, S.W.*
1891. Dec. 14	Young, Robert Magill, B.A., C.E. *Rathvarna, Antrim-road, Belfast.*

HONORARY MEMBERS.

Date of Election.	
1868. June 22	His Royal Highness Albert Edward, Prince of Wales, K.G., K.T., K.P.

"*The* President of the Royal Society, and Ex-Presidents *of the same, are always considered Honorary Members of the Academy.*"—By-Laws, ii., 14.

1869. Mar. 16 (Elected Hon. Mem. in Sec. of Science originally.)	Hooker, Sir Joseph Dalton, K.C.S.I., Ex-President of the Royal Society. *Sunningdale, Berks.*
1873. Mar. 15 (Elected Hon. Mem. in Sec. of Science originally.)	Stokes, Sir George Gabriel, Bart., Ex-President of the Royal Society. *Cambridge.*
1878. Mar. 16 (Elected Hon. Mem. in Sec. of Science originally.)	Kelvin, Right Hon. William, Baron, Ex-President of the Royal Society. *Glasgow.*
1886. Mar. 16	Lister, Right Hon. Joseph, Baron, President of the Royal Society. *London.*

SECTION OF SCIENCE.

[*Limited to 30 Members, of whom one-half at least must be foreigners.*]

1874. Mar. 16	Berthelot, Marcelin Pierre Eugène. *Paris.*
1875. Mar. 16	Bertrand, Joseph Louis François. *Paris.*
1896. Mar. 16	Bonney, Rev. Thomas George. *London.*
1869. Mar. 16	Bunsen, Robert Wilhelm Eberard. *Heidelberg.*
1869. Mar. 16	Carus, Julius Victor. *Leipzig.*
1898. Mar. 16	Cremona, Luigi. *Rome.*
1893. Mar. 16	Darwin, George Howard. *Cambridge.*
1896. Mar. 16	Flower, Sir William, K.C.B. *London.*

HONORARY MEMBERS—Section of Science—Continued.

Date of Election.	
1894. Mar. 16	Foster, Michael, Secretary, Royal Society. *Cambridge.*
1886. Mar. 16	Frankland, Edward. *Reigate, Surrey.*
1898. Mar. 16	Groth, Paul Heinrich. *Munich.*
1876. Mar. 16	Haeckel, Ernst. *Jena.*
1884. Mar. 15	Hermite, Charles. *Paris.*
1879. Mar. 16	Huggins, Sir William, K.C.B. *London.*
1897. Mar. 16	Kölliker. Albert Von. *Würzburg.*
1897. Mar. 16	Lévy, A. Michel. *Paris.*
1898. Mar. 16	Lubbock, Right Hon. Sir John, Bart. *London.*
1880. Mar. 16	Marsh, Othniel C. *New Haven, U.S.A.*
1889. Mar. 16	Mendeleeff, Dimitri Ivanovitch. *St. Petersburg.*
1882. Mar. 16	Newcomb, Simon. *Washington.*
1884. Mar. 16	Nordenskjöld, Baron Adolf Erik de. *Stockholm.*
1896. Mar. 16	Ramsay, William. *London.*
1886. Mar. 16	Rayleigh, Right Hon. John William, Baron. *Witham, Essex.*
1898. Mar. 16	Richthofen, Baron Ferdinand Von. *Berlin.*
1893. Mar. 16	Strasburger, Eduard. *Bonn.*
1895. Mar. 16	Suess, Eduard. *Vienna.*
1890. Mar. 16	Turner, Sir William. *Edinburgh.*
1882. Mar. 16	Virchow, Rudolph. *Berlin.*
1885. Mar. 16	Williamson, Alexander William. *Haslemere, Surrey.*
	(*One vacancy.*)

SECTION OF POLITE LITERATURE & ANTIQUITIES.

[*Limited to 30 Members, of whom one-half at least must be foreigners.*]

Date of Election.	
1888. Mar. 16	Anderson, Joseph. *Edinburgh.*
1882. Mar. 16	Ascoli, Graziadio Isaia. *Milan.*
1889. Mar. 16	Benavides, Don Antonio. *Madrid.*
1888. Mar. 16	Blass, Friedrich. *Halle.*
1848. Nov. 30	Botta, Paul Emile. *Paris.*
1888. Mar. 16	Brugmann, Karl. *Leipzig.*
1888. Mar. 16	Ceriani, Antonio. *Milan.*
1891. Mar. 16	Delisle, Léopold. *Paris.*
1888. Mar. 16	Duchesne, Louis. *Rome.*
1883. Mar. 16	Erman, Adolf. *Berlin.*
1888. Mar. 16	Evans, Sir John, K.C.B., Treasurer, Royal Society. *Nash Mills, Hemel Hempstead.*
1890. Mar. 16	Fick, F. C. Augustus. *Göttingen.*
1883. Mar. 16	Gardiner, Samuel Rawson. *Bedford.*
1889. Mar. 16	Herbst, Christian Frederick. *Copenhagen.*
1888. Mar. 16	Hübner, Emil. *Berlin.*
1878. Mar. 16	Kern, H. *Leyden.*
1884. Mar. 16	Maury, Louis Ferdinand Alfred. *Paris.*
1889. Mar. 16	Mommsen, Theodor. *Berlin.*
1888. Mar. 16	Montelius, Gustav Oscar Augustin. *Stockholm.*
1883. Mar. 16	Müller, Max. *Oxford.*
1888. Mar. 16	Munro, Robert. *Edinburgh.*

Section of Polite Literature and Antiquities—Continued.

Date of Election.	
1873. Mar. 15	Nigra, His Excellency Cavaliere Constantino. *Vienna.*
1895. Mar. 16	Pitt-Rivers, Lieut.-General Augustus H. L. F., *Salisbury.*
1891. Mar. 16	Sayce, Rev. Archibald Henry. *Oxford.*
1876. Mar. 16	Stokes, Margaret. *Howth, Co. Dublin.*
1876. Mar. 16	Stubbs, Right Rev. William, Lord Bishop of Oxford. *Oxford.*
1889. Mar. 16	Thompson, Sir Edward Maunde, K.C.B. *London.*
1867. Mar. 16	Visconti, Barone Commendatore P. E. *Rome.*
1876. Mar. 16	Windisch, Ernst. *Leipzig.*
1895. Mar. 16	Zeller, Eduard. *Berlin.*

NAMES OF PERSONS TO WHOM THE CUNNINGHAM GOLD MEDALS HAVE BEEN AWARDED.

Year.	Name.	Year.	Name.
1796	Wallace, Thomas	1858	Salmon, George
1800	Swift, Theophilus	1858	Wall, Charles William
1805	Preston, William	1858	Reeves, William
1818	Brinkley, John	1862	Lloyd, Humphrey
1827	D'Alton, John	1862	Mallet, Robert
1830	Petrie, George	1862	Stokes, Whitley
1833	Petrie, George	1862	Gilbert, John Thomas
1834	Hamilton, Sir Wm. Rowan	1873	Wilde, Sir William R. W.
1838	MacCullagh, James	1878	Smith, Aquilla
1839	Apjohn, James	1878	Casey, John
1839	Petrie, George	1878	Dowden, Edward
1843	Kane, Sir Robert	1878	Allman, George James
1848	Hamilton, Sir Wm. Rowan	1879	Archer, Wiliam
1848	Haughton, Samuel	1879	Ball, Robert Stawell
1848	Hincks, Edward	1881	Grubb, Howard
1848	O'Donovan, John	1883	Wright, Edward Perceval
1851	Jellett, John Hewitt	1884	Birmingham, John
1858	Cooper, Edward J.	1885	Malet, John Christian

AUTHORS OF CUNNINGHAM MEMOIRS.

I.—John Casey, ... 1880
II.—Daniel John Cunningham, . . . 1886
III.—Samuel Haughton, ... 1886
IV.—Sir Robert Stawell Ball, ... 1887
V.—John Birmingham, ... 1890
VI.—William Kitchen Parker, ... 1890
VII.—Daniel John Cunningham, . . . 1891
VIII.—John Pentland Mahaffy, ... 1891
IX.—John Pentland Mahaffy, ... 1893
X.—Alfred Cort Haddon, ... 1895

APPENDIX.

PRESIDENTS AND OTHER OFFICERS OF THE ROYAL IRISH ACADEMY, FROM 1785 TO 1898.

I.—Presidents.

II.—Treasurers.

III.—Secretaries of the Academy.

IV.—Secretaries of the Council.

V.—Librarians.

VI.—Secretaries of Foreign Correspondence.

VII.—Assistant Secretaries.

VIII.—Todd Professors of the Celtic Languages.

APPENDIX.

Presidents and other Officers of the Royal Irish Academy, from 1785 to 1896.

I.—PRESIDENTS.

Date of Election.	
1785. May 2	Charlemont, Right Hon. The Earl of, LL.D., F.R.S. (*a*)
1799. Oct. 26	Kirwan, Richard, LL.D., F.R.S. (*b*)
1812. June 22	Charleville, Right Hon. The Earl of. (*c*)
1822. Mar. 16	Brinkley, Right Rev. John, D.D., F.R.S. (*d*)
1835. Nov. 9	Lloyd, Rev. Bartholomew, D.D. (*e*)
1837. Dec. 11	Hamilton, Sir William Rowan, LL.D., D.C.L. (*f*)
1846. Mar. 16	Lloyd, Rev. Humphrey, D.D., F.R.S. (*g*)
1851. Mar. 15	Robinson, Rev. Thomas Romney, D.D., LL.D., D.C.L., F.R.S. (*h*)
1856. Mar. 15	Todd, Rev. James Henthorn, D.D. (*i*)
1861. Mar. 16	Graves, Very Rev. Charles, D.D., F.R.S. (*j*)
1866. Mar. 16	Malahide, Right Hon. Lord Talbot de, LL.D., F.R.S. (*k*)
1869. Nov. 30	Jellett, Rev. John Hewitt, D.D. (*l*)
1874. Mar. 16	Stokes, William, M.D., LL.D., D.C.L., F.R.S. (*m*)
1877. Mar. 16	Kane, Sir Robert, M.D., LL.D., F.R.S. (*n*)
1882. Mar. 16	Ferguson, Sir Samuel, LL.D., Q.C. (*o*)
1886. Nov. 8	Haughton, Rev. Samuel, M.D., D.C.L., LL.D., F.R.S. (*p*)
1891. Mar. 16	Reeves, Right Rev. William, D.D., M.B., LL.D. (*q*)
1892. Feb. 8	Ingram, John Kells, LL.D. (*r*)
1896. Mar. 16	**Rosse, Rt. Hon. the Earl of, K.P., LL.D., F.R.S.** (*s*)

(*a*) Died, 1799, while President of the Academy. (*b*) Died, 1812, while President of the Academy. (*c*) Died, 1835. (*d*) Bishop of Cloyne, 1829; died, 1835, while President of the Academy. (*e*) Provost of Trinity College, Dublin, 1831; died, 1837, while President of the Academy. (*f*) Astronomer Royal for Ireland; died, 1865. (*g*) Provost of Trinity College, Dublin, 1867; died, 1881. (*h*) Fellow of Trinity College, Dublin; died, 1882. (*i*) Senior Fellow of Trinity College, Dublin; died, 1869. (*j*) Senior Fellow of Trinity College, Dublin; Dean of the Chapel Royal, Dublin, 1860; Bishop of Limerick, 1866. (*k*) Died, 1883. (*l*) Provost of Trinity College, 1881; died, 1888. (*m*) Died, 1878. (*n*) President of Queen's College, Cork, 1850–1873; died, 1890. (*o*) Died, 1886, while President of the Academy. (*p*) Senior Fellow of Trinity College, Dublin; died 1897. (*q*) Dean of Armagh, 1875; Bishop of Down and Connor, and Dromore, 1886; died, 1892. (*r*) Vice-Provost of Trinity College, Dublin, 1898. (*s*) Chancellor of the University of Dublin.

II.—TREASURERS.

Date of Election.	
1785. May 2	Conyngham, Right Hon. William Burton, M.P. (*a*)
1796. Nov. 5	Blaquiere, Colonel James.
1803. Mar. 16	Shaw, Robert.
1806. May 12	Guinness, Samuel.
1806. May 29	Hill, Colonel Hugh.
1810. Mar. 16	Prior, Rev. Thomas, D.D. (*b*)
1817. Mar. 15	Brooke, William, M.D. (*c*)
1829. July 27	Orpen, Thomas Herbert, M.D. (*d*)
1841. Nov. 30	Smith, Aquilla, M.D. (*e*)
1842. Mar. 16	Pim, James. (*f*)
1844. April 8	Ball, Robert, LL.D. (*g*)
1857. April 27	Carson, Rev. Joseph, D.D. (*h*)
1867. May 27	Hardinge, William Henry. (*i*)
1871. Mar. 16	Garstin, John Ribton, M.A.
1878. Nov. 30	**Close, Rev. Maxwell Henry, M.A.**

(*a*) Died, 1796. (*b*) Vice-Provost of Trinity College, Dublin, 1840; died, 1843. (*c*) Died, 1829. (*d*) Died, 1846. (*e*) Died, 1890. (*f*) Died, 1856. (*g*) Died, 1857. (*h*) Vice-Provost of Trinity College, Dublin, 1890; died 1898. (*i*) Died, 1871.

III.—SECRETARIES OF THE ACADEMY.*

Date of Election.	
1785. May 2	Perceval, Robert, M.D. (*a*)
1789. Mar. 16	†Stack, Rev. John, M.A. (*b*)
1791. June 11	M'Nevin, William James, M.D. (*c*)
1792. Mar. 16	Hall, Rev. George, D.D. (*d*)
1794. Mar. 15	†Burrowes, Rev. Robert, D.D. (*e*)
1796. Mar. 16	†Elrington, Rev. Thomas, D.D. (*f*)
1802. Mar. 15	†Miller, Rev. George, D.D. (*g*)
1805. Mar. 16	Preston, William. (*h*)
1807. Feb. 26	†Davenport, Rev. William, D.D. (*i*)
1816. Mar. 16	†Singer, Rev. Joseph Henderson, D.D. (*k*)
1842. May 9	†MacCullagh, James, LL.D. (*l*)
1846. Mar. 16	†Todd, Rev. James Henthorn, D.D. (*m*)
1856. Mar. 18	†Graves, Rev. Charles, D.D., F.R.S. (*n*)
1861. Mar. 16	Reeves, Rev. William, M.B., D.D. (*o*)
1867. Mar. 16	Sullivan, William, Kirby, PH.D. (*p*)
1874. Mar. 16	Wright, Edward Perceval, M.A., M.D. (*q*)
1877. June 25	Ball, Sir Robert Stawell, LL.D., F.R.S. (*r*)
1880. June 28	Macalister, Alexander, M.D., F.R.S. (*s*)
1883. Nov. 30	**Wright, Edward Perceval, M.A., M.D.** (*q*)

* By the Charter [enrolled January 28, 1786], Robert Perceval, Doctor of Physic, was declared "to be the first and modern Secretary to the Academy." A resolution was passed by the Academy, on November 23, 1799: "That there shall be two Secretaries of the Royal Irish Academy, who shall attend all meetings of the Academy and Council." *See* "SECRETARIES OF THE COUNCIL."

† Those marked thus were Fellows of Trinity College, Dublin.

(*a*) Died, 1839. (*b*) Died, 1813. (*c*) Died, 1841. (*d*) Provost of Trinity College, Dublin, 1806; Bishop of Dromore, 1811; died, 1811. (*e*) Died, 1841. (*f*) Provost of Trinity College, 1811; Bishop of Limerick, 1820; Bishop of Leighlin and Ferns, 1822; died, 1835. (*g*) Died, 1848. (*h*) Died, 1807. (*i*) Died, 1824. (*k*) Bishop of Meath, 1852; died, 1866. (*l*) Died, 1847. (*m*) President of the Academy, 1856–1861; died, 1862. (*n*) Dean of the Chapel Royal, Dublin, 1860; Bishop of Limerick, 1866; President of the Academy, 1861–1866. (*o*) Dean of Armagh, 1875; Bishop of Down and Connor, and Dromore, 1886; President of the Academy, 1891. (*p*) President of Queen's College, Cork, 1873; died, 1890. (*q*) Professor of Botany, University of Dublin, 1869. (*r*) Astronomer Royal for Ireland, 1874; Lowndean Professor of Astronomy and Geometry, University of Cambridge, 1892. (*s*) Fellow of St. John's College, and Professor of Anatomy in the University of Cambridge, 1883.

IV.—SECRETARIES OF THE COUNCIL.*

Date of Election.	
1785. July 4	*†Ussher, Rev. Henry, D.D., F.R.S. (*a*)
1787. Mar. 19	*†Hall, Rev. George, D.D. (*b*)
1790. Mar. 20	*†Elrington, Rev. Thomas, D.D. (*c*)
1791. April 9	*†Burrowes, Rev. Robert, D.D. (*d*)
1794. Mar. 29	*†Miller, Rev. George, D.D. (*e*)
1800. Mar. 15	†Miller, Rev. George, D.D. (*e*)
1802. Mar. 16	Preston, William. (*f*)
1805. Mar. 16	Stephens, Rev. Walter. (*g*)
1806. Mar. 15	†Davenport, Rev. William, M.A. (*h*)
1807. Feb. 23	†Kyle, Rev. Samuel, D.D. (*i*)
1814. Mar. 16	†Singer, Rev. Joseph Henderson, D.D. (*j*
1816. Mar. 16	†Sadlier, Rev. Franc, D.D. (*k*)
1829. July 27	†MacDonnell, Rev. Richard, D.D. (*l*)
1838. Mar. 16	†Lloyd, Rev. Humph., D.D., F.R.S. (*m*)
1840. Mar. 16	†MacCullagh, James, LL.D. (*n*)
1842. May 9	Kane, Sir Robert, M.D., F.R.S. (*o*)
1846. Mar. 16	†Graves, Rev. Charles, D.D., F.R.S. (*p*)
1854. Mar. 16	†Jellett, Rev. John Hewitt, M.A. (*q*)
1860. Feb. 13	†Ingram, John Kells, LL.D. (*r*)
1878. Mar. 16	**Atkinson, Robert, LL.D.** (*s*)

* The Secretaries of the Council were first called "Junior Secretaries." The first five were elected by the Council.

A resolution was passed by the Academy on November 23, 1799: "That there shall be two Secretaries of the Royal Irish Academy, who shall attend all meetings of the Academy and Council." *See* "SECRETARIES OF THE ACADEMY."

† Those marked thus were Fellows of Trinity College, Dublin.

(*a*) Died, 1790. (*b*) Provost of Trinity College, Dublin, 1806; Bishop of Dromore, 1811; died, 1811. (*c*) Provost of Trinity College, 1811; Bishop of Limerick, 1820; Bishop of Leighlin and Ferns, 1822; died, 1835. (*d*) Died, 1841. (*e*) Died, 1848. (*f*) Died, 1848. (*g*) Died, 1807. (*h*) Died, 1824. (*i*) Provost of Trinity College, Dublin; Bishop of Cork, 1831; died, 1848. (*j*) Bishop of Meath, 1852; died, 1866. (*k*) Provost of Trinity College, Dublin, 1837; died, 1851. (*l*) Provost of Trinity College, Dublin, 1852; died, 1867. (*m*) Provost of Trinity College. Dublin, 1867; President of the Academy, 1846–1851; died, 1881. (*n*) Died, 1847, (*o*) President of Queen's College, Cork, 1850–1873; President of the Academy, 1877–1882; died, 1890. (*p*) Dean of the Chapel Royal, Dublin, 1860; President of the Academy, 1861–1866; Bishop of Limerick, 1866. (*q*) Provost of Trinity College, 1881; President of the Academy, 1869–1874; died, 1888. (*r*) Regius Professor of Greek, University of Dublin, 1866; Librarian, Trinity College, 1879; President of the Academy, 1892; Vice-Provost of Trinity College, 1898. (*s*) Professor of Sanskrit and Comparative Philology in the University of Dublin, 1871.

V—LIBRARIANS.

Date of Election.	
1788. Mar. 15	Beaufort, Rev. Daniel Agustus, LL.D. (*a*)
1791. Mar. 16	Kirwan, Richard, LL.D., F.R.S. (*b*)
1800. Mar. 15	Davenport, Rev. William, M.A. (*c*)
1806. Mar. 14	Stephens, Rev. Walter.
1808. Dec. 19	Prior, Rev. Thomas, D.D. (*d*)
1810. Mar. 16	Brooke, William, M.D. (*e*)
1817. Mar. 16	Robinson, Rev. Thomas Romney, M.A., F.R.S. (*f*)
1822. Mar. 16	Drummond, Rev. William Hamilton, D.D. (*g*)
1861. Mar. 16	Gilbert, John Thomas.
1876. Mar. 16	Atkinson, Robert, LL.D. (*h*)
1878. Mar. 16	Gilbert, John Thomas, F.S.A.
1887. Mar. 16	Frazer, William, F.R.C.S.I.
1888 Mar. 16	Gilbert, Sir John Thomas, LL.D., F.S.A.

(*a*) Died, 1831. (*b*) President of the Academy, 1799–1812; died, 1812. (*c*) Fellow of Trinity College, Dublin; died, 1824. (*d*) Vice-Provost, Trinity College, Dublin, 1810; died, 1843. (*e*) Died, 1829. (*f*) Fellow of Trinity College, Dublin; President of the Academy, 1851–1856; died, 1882. (*g*) Died, 1865. (*h*) Professor of Sanscrit and Comparative Philology in the University of Dublin, 1871; Secretary of Council of the Academy, 1878.

VI.—SECRETARIES OF FOREIGN CORRESPONDENCE.

Date of Election.	
1785. May 2	Ussher, Rev. Henry, D.D. (*a*)
1790. June 26	Graydon, Rev. George, LL.B.
1791. Mar. 16	Perceval, Robert, M.D. (*b*)
1792. Mar. 16	Graydon, Rev. George, LL.B.
1808. Mar. 16	Hill, Colonel Hugh.
1811. Mar. 16	Hill, Colonel Edward
1828. Nov. 29	Betham, Sir William (*c*)
1839. May 27	MacCullagh, James, LLD. (*d*)
1840. Mar. 16	Lloyd, Rev. Humphrey, D.D., F.R.S. (*e*)
1846. Mar. 16	Butcher, Rev. Samuel, M.A. (*f*)
1856. Mar. 16	Wilde, William Robert Wills. (*g*)
1858. Dec. 18	Butcher, Rev. Samuel, D.D. (*f*)
1864. Mar. 16	Wilde, Sir William Robert Wills, M.D. (*g*)
1874. Mar. 16	M'Donnell, Robert, M.D., F.R.S. (*h*)
1875. Mar. 16	Archer, William, F.R.S. (*i*)
1879. Mar. 15	O'Reilly, Joseph P., C.E. (*k*)

(*a*) Fellow of Trinity College, Dublin; died, 1790. (*b*) Secretary of the Academy, 1785–1789; died, March, 1839. (*c*) Died, 1853. (*d*) Fellow of Trinity College, Dublin; died, 1847. (*e*) Provost of Trinity College, Dublin, 1867; President of the Academy, 1846–1851; died, 1881. (*f*) Fellow of Trinity College, Dublin; Bishop of Meath, 1866; died, 1876. (*g*) Died, 1876. (*h*) Died, 1889. (*i*) Librarian, National Library of Ireland, 1878–1895; died, 1897. (*k*) Professor of Mining and Mineralogy, Royal College of Science for Ireland.

VII.—ASSISTANT SECRETARIES.

Date of Election.	
1790. Mar. 16	Hayes, John.
1816. Aug. 26	Roe, Rev. Richard, B.A.
1834. Mar. 15	Roe, James.
1839. Mar. 16	Clibborn, Edward. (*a*)
1880. June 28	Edgar, Alfred, B.A.
1882. Feb. 13	**Macalister, Robert, LL.B.**

VIII.—TODD PROFESSORS OF THE CELTIC LANGUAGES.

Date of Election.	
1879. Dec. 1	Hennessy, William Maunsell. (*b*)
1884. Dec. 15	Atkinson, Robert, LL.D. (*c*)
1887. Dec. 19	MacCarthy, Rev. Bartholomew, D.D.
1891. June 15	Hogan, Rev. Edmund, S.J. (*d*)
1894. June 18	Hogan, Rev. Edmund, S.J., D.LITT. (*d*)
1898. May 4	**Gwynn, Edward John, M.A.** (*e*)

(*a*) Died, 1880. (*b*) Died, 1889. (*c*) Professor of Sanskrit and Comparative Philology in the University of Dublin, 1871. (*d*) Fellow of the Royal University of Ireland. (*e*) Fellow of Trinity College, Dublin.

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